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MAKING ICE BY MACHINERY AT THE KNICKERBOCKER ICE COMPANY'S EDGEWATER PLANT

ONE of the industries which adds greatly to the comfort of people during the extreme heat of the summer and makes possible the preservation of food products during all seasons of the year is that of making ice by machinery.

The process by which this result is obtained is com-

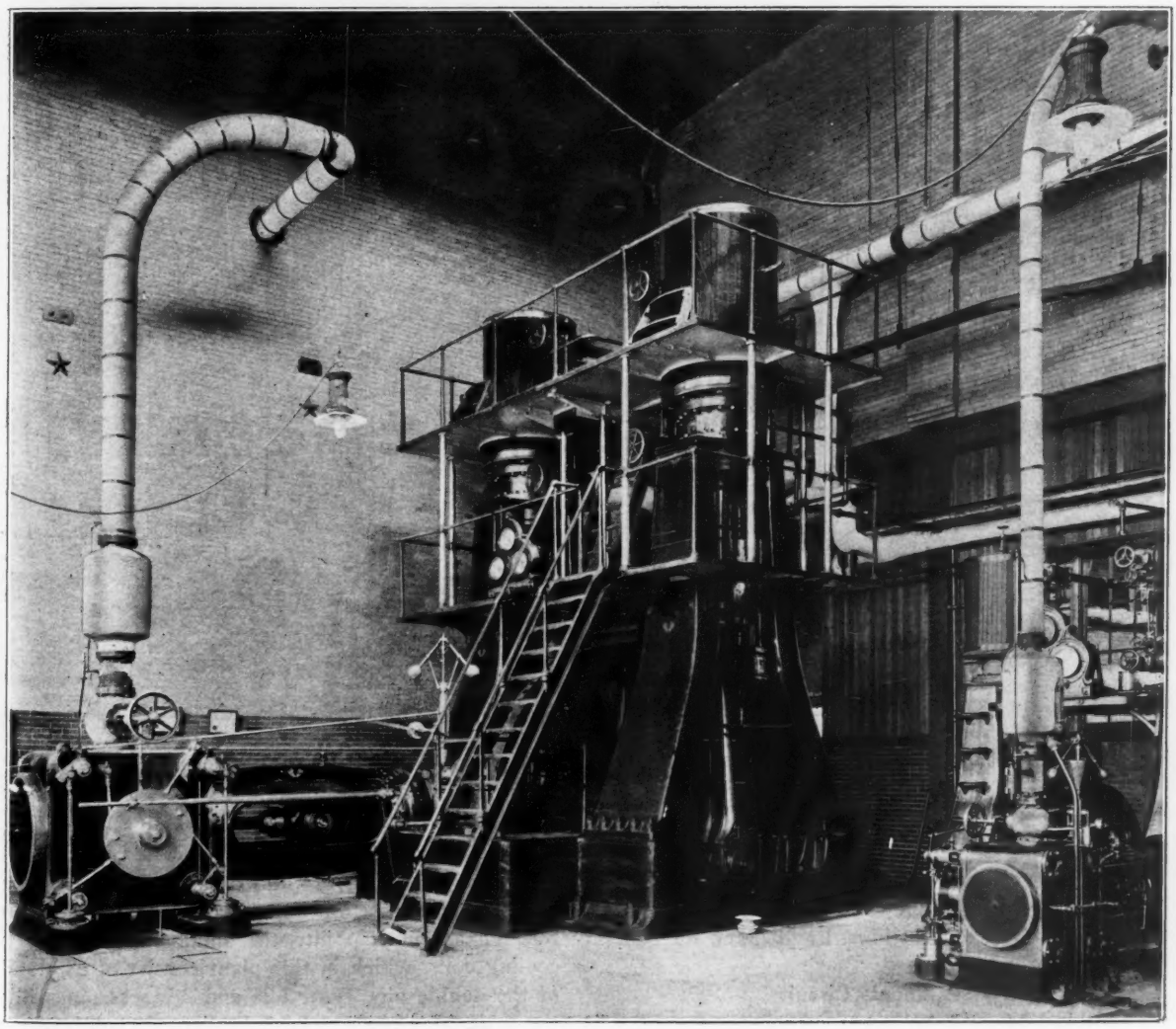


FIG. 1. YORK AMMONIA COMPRESSORS IN KNICKERBOCKER ICE CO.'S PLANT

paratively simple, being based upon the principle that the compression of a gas by mechanical means causes its temperature to rise and, conversly, the expansion of the gas lowers its temperature. By cooling down compressed gas and then by the expansion of the gas absorbing heat from the surrounding medium, a transfer of heat units is obtained, which, if properly applied, will result in a very low temperature.

The Knickerbocker Ice Co. operates a number of ice plants in the city of Chicago, but one of the largest and most modern is its Edgewater plant, the engine room of which is illustrated in Figs. 1 and 2, and the general plan shown in Fig. 3.

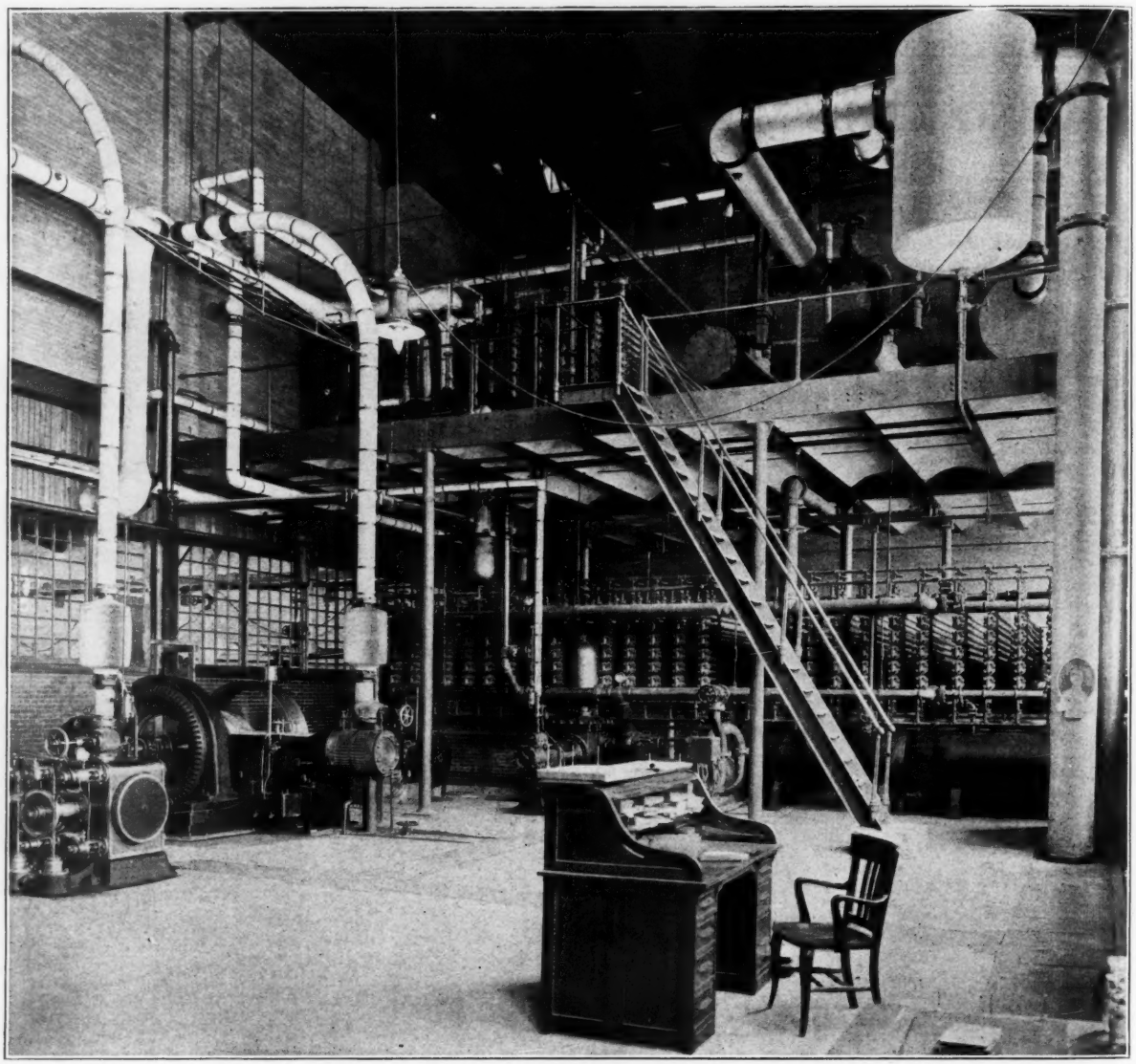


FIG. 2. GENERATING UNIT, BRINE COILS AND MEZZANINE FLOOR

Ammonia Circuit

In this plant the ammonia compression system is used, employing anhydrous ammonia as the refrigerating medium; its circuit is shown in Fig. 4. Anhydrous ammonia, which is ammonia containing no water, is placed in a receiver under pressure, from which it is allowed to flow through a back pressure or pressure regulating valve into a series of coils surrounded by brine. In these coils the pressure upon the ammonia is reduced and the ammonia in becoming a vapor takes the necessary heat for this physical change from the surrounding brine.

The gas, as it leaves the expansion coils, is drawn into a compressor or ammonia pump and forced through an oil trap into the ammonia condenser or cooling coils, which in this plant consist of 28 stands of the double pipe type, 1.25 and 2 in., 12 pipes high by 19 ft. long, with rewash headers. Their capacity is 350 tons refrigeration of water at 60 deg. F.

The inner pipe of these coils contains the ammonia gas which has become heated by the compression to which it has been subjected. The outer pipe contains cooling water, which surrounds the ammonia pipe. In the York system of refrigeration, which is employed throughout the plant, the directions of the flow of the cooling water and the ammonia through the pipes are opposite, by which arrangement the greatest efficiency is obtained.

When the gas has become sufficiently cooled by the

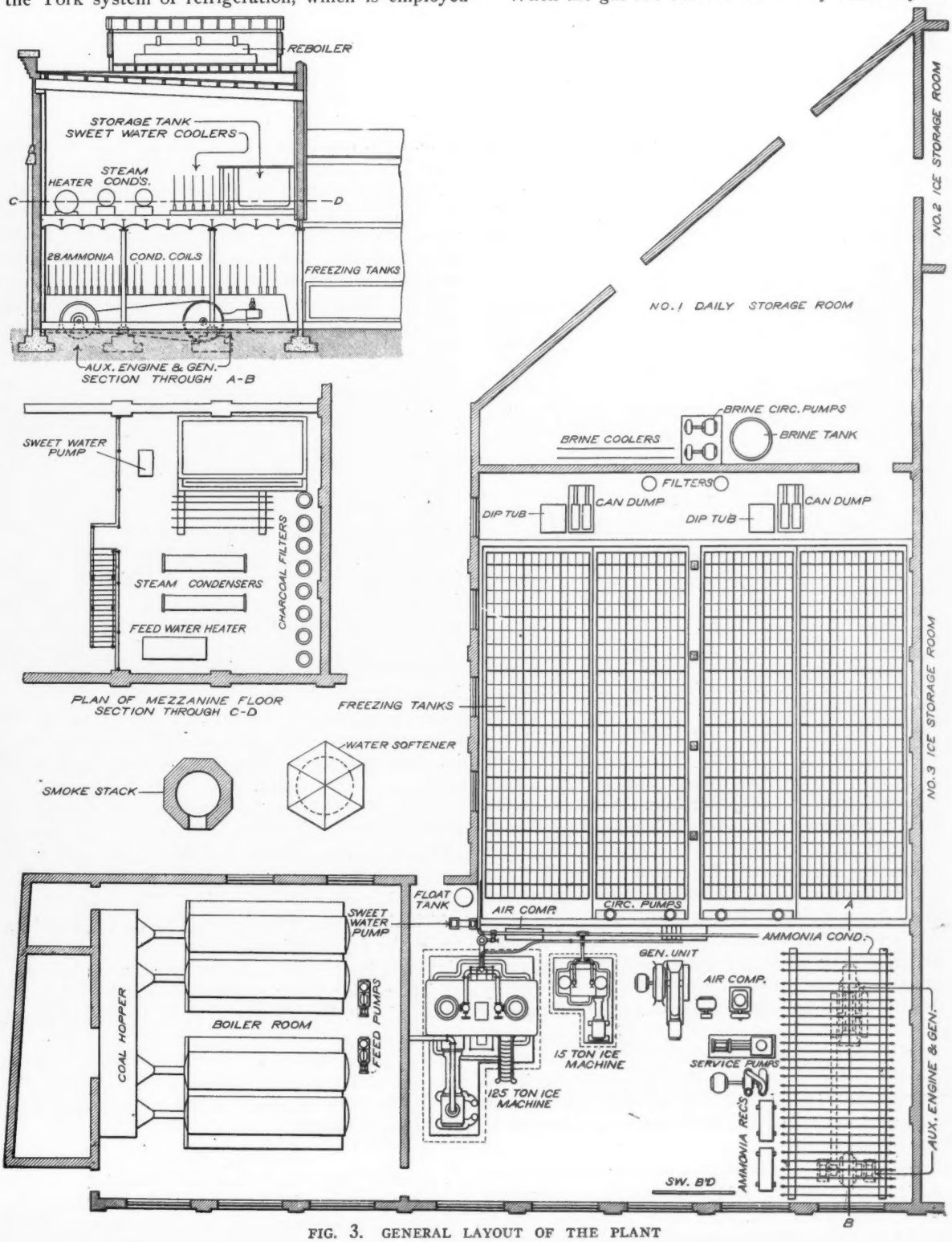


FIG. 3. GENERAL LAYOUT OF THE PLANT

water, it is condensed into a liquid and is drained to the receivers, from which the ammonia goes through the same process. The receivers employed at this station are 2 in number, 28 in. in diameter by 6.5 ft. in length, and lie in a horizontal position.

In order that the ammonia gas may be perfectly free from oil which is used for lubricating the compressor cylinder, it is necessary to employ oil traps, as stated above, especially designed for the purpose of removing all entrained oil. For this purpose 2 oil traps, one on each discharge line from the compressor, are used in this station.

The Distilled Water Course

All water used for ice making in this plant is obtained by condensing the exhaust from the engines

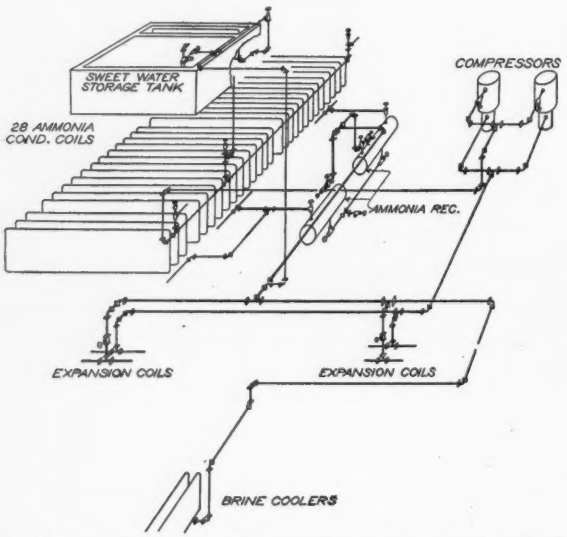


FIG. 4. OUTLINE OF AMMONIA PIPE LINES CONNECTIONS

which furnish power for the plant and its course is shown in Fig. 5. A specially designed York oil separator is installed on the exhaust lines for the purpose of removing all oil and grease from the exhaust steam. From the separator the exhaust is piped to 2 Worthington surface condensers which have 500 sq. ft. of condensing surface. The condensed water is then drained to a float trap, from which a sweet-water steam pump forces the water to the reboiler.

The reboiler is a metal lined tank fitted with steam coils and supplied with a patent regulator and skimming device, from which the sweet water flows by gravity to the cooling or flat coils. For the purpose of cooling the sweet water, 5 double pipe cooling coils, 12 pipes high by 17 ft. long of 2 in. and 1.25 in. galvanized piping, are employed. When the water has become cool, it is forced through charcoal filters of the standard York type, 8 of which are installed in this station.

From the filters, the water is discharged into a storage tank, which is provided with a direct expansion ammonia coil, the tank being made of 0.25-in. iron, 19 by 8.5 by 6 ft. in dimensions.

From the storage tank the water is drawn through a centrifugal sweet-water pump, made by the Platt Iron Works and direct connected to a Westinghouse motor; it forces the sweet water through coils of the double pipe style, employing the direct expansion of the ammonia gas for cooling the water. After passing through these pipes, the water is forced through another International filter, 2 of which are installed in this plant, thence to the automatic can fillers.

Freezing cans used in this plant are 11.5 by 22.5 by 58 in. each, making 400 lb. of ice; the capacity of the plant being 1,350 cans.

After the cans have been filled, they are lowered into the brine which surrounds the ammonia expansion pipes until the water contained in the cans is frozen, when they are removed by pneumatic hoists, and lowered into the dip tubs containing warm water to loosen the ice from the sides of the can; the ice is then removed by placing the cans in the dumps, which turn them and allow the ice to slide through chutes into the storage room.

Service Water

The water used in this station is obtained either from a deep well pumped by a W. B. Erb double acting direct connected steam pump or from a 4-in. city supply pipe, a Kennicott type B water softener being used to purify the water before it is discharged into the reservoir beneath the cooling tower.

Two service pumps, shown in Fig. 6, are employed for circulating the water through the cooling coils, feed water heater, condensers, etc. Either one of these pumps is sufficiently large to do the work, but one is held in reserve for cases of emergency. The steam pump is of the Marsh type, 10 by 14 by 20 in., with 10 in. suction and 8 in. discharge connections. The other pump is of the 2-stage centrifugal type, made by the American Steam Pump Co., with 7 in. suction and 6 in. discharge connections, direct driven by a 40-hp. Fairbanks-Morse motor.

From these pumps the water is forced through the ammonia condensing coils, exhaust steam condensers, and sweet water coolers, and then to the roof of the storage rooms, where it is conducted by a trough to the cooling tower shown in Fig. 7. The trough through which the heated water runs is metal lined and extends the full length of the storage rooms, keeping the water in constant agitation by means of baffles.

The cooling tower consists of a number of shelves made of 1-in. boards placed ⅜ in. apart, the boards on alternate shelves running at right angles to each other. Water falling on the top shelf drips through the cracks and over the sides to the shelves below, falling into the reservoir at the bottom, cooled and ready for use again.

Freezing Room

Figures 8 and 9 give a general idea of the arrangement of apparatus in the freezing room. The freezing tanks are 2 in number, made of 0.25-in. steel, each 62.25

(*Continued on page 200.*)

POWER TRANSMISSION BY STEEL BELTS

THE STEEL BAND IS RAPIDLY REPLACING OTHER TYPES IN GERMANY

By H. Prime Kieffer

THE problem of power transmission by steel belts is relatively old. The idea of replacing belts of leather, ropes, chains, etc. by materials of greater strength is quite natural. The greatest and most practical specialists of many countries have agreed that the problem could not be successfully solved. This view is justified in so far as the difficulties to be overcome are of an extraordinary nature, so that a long period of careful work and thought was necessary before the practical solution of the problem was reached.

That it has been reached no one who has investigated the subject will deny, no matter how skeptical he may be of the use of steel bands or belts in the place of other materials. Steel belts are being rapidly introduced in Germany and many of the large factories and power stations have installed them and are getting excellent results.

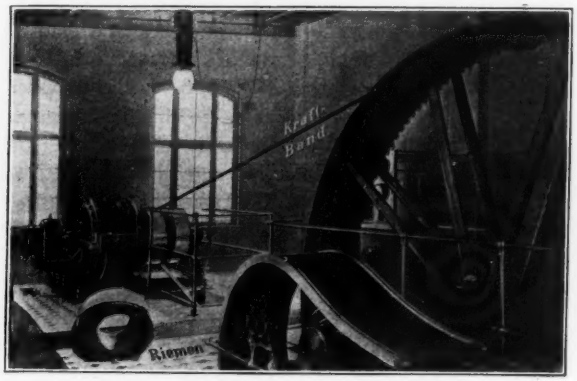


FIG. 1. THE STEEL BELT ON TEST

This system of transmission, for it is a system, is the invention of D. Eloesser, architect for the German government, who is now at the head of the company in Berlin which is manufacturing the belts.

Theoretically, it was undoubtedly correct to use a steel band for the purpose of power transmission. Theory was however of no avail when it came to the means of locking the ends of the belt. The general principle of the theory led at once to the lock, and this lock is the keynote, if such a term may be used in a mechanical sense, of the success of the system. It will therefore be described in detail.

The lock consists of 2 parts, one for each end of the steel belt. These parts, when the belt is ready to be installed, are placed into each other by a locking device, and screwed together, as is well shown in Fig. 2.

In each part of the lock the end of the steel belt reaches up to the point O. These ends are secured to the lock by screwing and soldering.

The first locks which were made were all in one piece and the ends of the steel band had therefore to be soldered in place at the point of installation. With the lock shown in the diagram all the soldering may be accomplished at the point of manufacture of the belt, by experts, so that at the receiving station the belt needs only to be locked together and secured by a row of screws.

It was found that the heating of the steel band in the receiving station, during the soldering process, was not the best method as the workmen were too prone to overheat the metals. The temperature of the solder should in no case be over 390 deg. F. as even a low overheating would ruin the temper of the belt.

The curves of the 2 flanges of the locks have to be designed according to the diameters of the pulleys over which the belt will travel. The theory of this design is not public and was secured by the inventor only after months of labor and experiment. The steel for the belt is manufactured especially for the purpose, and is of extraordinary quality and temper.

Although the steel belt will run directly on the clear metal pulley it has been found advantageous to cover the pulley with sheets of canvas to which are glued fine sheets of cork. This is done to prevent absolutely any slipping. As the bands are highly polished, this cork will last for many years. They would not last so long, however, if the belts did slip, but it has been ascertained in practice and in tests that the slipping is less than 0.1 of 1 per cent. The very fact that this cork covering shows no wear proves there is absolutely no slipping.

The method followed in getting the exact length of a belt for a new installation is not difficult but interesting. A small steel tape is placed over the crowns of the pulleys and the ends of the tape are then lapped and cut with shears. This does not give the exact length however. The inventor has patented a device to measure the length of the tapes under a tension of about 45 lb. around the pulleys and the length found in that way is the true length of the steel belt.

Tests of Steel Belts

It is almost inconceivable what power can be carried by a steel belt. Professor Reg. Kaemmerer of the Technical High School, Berlin, experimented at the laboratory of the high school with a steel belt 0.3937 in. wide and 0.0197 in. thick. These experiments were conducted on 2 pulleys each having a diameter of 98.5 in.

Professor Kaemmerer attests to the following important results from these trials:—

That the steel belts ran absolutely true without guides, over the metal surfaces of the pulleys without

any pulley covering. That the steel belt ran as steadily, and noiselessly at a velocity of 186 ft. a second as at a velocity of 42.7 ft. a second. A maximum of 146 hp. was conveyed at a tension of 440.8 lb. while the maximum slipping was 0.15 of 1 per cent.

The loss of power by the belt during these tests, even with small loads and great velocities was very small, generally always within the limit of errors of measurements. A stretching of the belt during the experiments was not ascertained.

The belt lock in this case, had been made with soft solder according to the direction of the inventor.

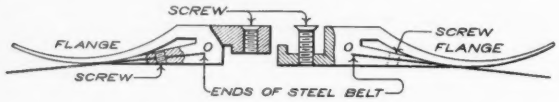


FIG. 2. BELT-LOCKING DEVICE

Further experiments show that there is no slipping whether the loads are steady or of great and sudden variations. The power is transmitted exactly in proportion to the pulley diameters. Steel belts do not stretch and there is therefore no necessity for taking up slack.

The width of steel belts is from 1/3 to 0.1 that of leather belts of equal capacity; consequently, there is a saving in the cost of pulleys as they can be much narrower. There is also more light in the workshops.

Steel belts do not wear and may be used in hot, damp or dusty places and they are not affected by the fumes of acids. Velocities up to 325 ft. a second or about 19,500 ft. a minute are permissible with these belts and they could therefore readily be used on turbines.

As the tension of steel belts is about 0.1 that of leather belts of equal capacity and also on account of their light weight they save the bearings and prevent their heating. As the effectiveness of steel belts is not dependent upon distances of centres, space can be saved by their installation. One feature greatly to their advantage is that they are perfectly clean and run without noise.

Steel belts work as true in perpendicular as in horizontal positions and have been employed in many cases where cog wheels were formerly used. They can be used for transmissions of 0.1 to several thousand hp. They are not merely substitutes for other belts, but they seem to me to be the very perfection of power transmission.

I am informed by the manufacturers of this new belt that in spite of all the advantages possessed by their belt, they are underselling the leather belting manufacturers. This is true especially in comparison with leather belts of first quality and correct proportions, and more so of course for large transmissions and complete plants.

Steel belts are a recent invention, the oldest in use having run a little over a year. I have found the owners and superintendents unanimous in their praise.

One firm, that of the Ludwig Sudicatis and Co. of Berlin, replaced a leather belt 23.62 in. wide with a steel belt 3.94 in. wide. Owing to the load changing abruptly they had great difficulty with the leather belt. The steel belt has been running since March, 1907, and transmits about 250 hp. without the slightest faults or stretching. There is no wear on the belt or on the pulley covering and there has never been a hot box. Although the load changes abruptly there is absolutely no slipping of the belt.

The only objection I have heard to the belts was that they might prove dangerous owing to their extreme thinness and might injure the unwary, but all belts should be enclosed by a protective screen, if located where they may be touched.

WHAT PACKING SHALL I USE?

PROPERTIES OF DIFFERENT CLASSES OF PACKINGS

By W. E. Sanders

THERE are these four principles, on which nonmetallic packings work, and we name them in order of steam economy:

First: The monkey-wrench packing, which depends upon pressure from the gland. The danger with this type of packing is that it will be forced up too tight and an excessive pressure produced on the rod. Even if there is not this excessive pressure, the grip depends on the skill of the engineer, and very often the engineer or pump runner knows little about the packing. The bad results are easily shown by the shoulders on a pump rod, which would not be there, or would be a much longer time in appearing, if the packing were properly done.

Second: Moisture packing, which depends on moisture to swell the packing and do the work. It is closely allied to the monkey-wrench packing, and like the monkey-wrench type, is not economical of steam.

Third: Expansion packing, which gets its grip on the rod upon the expansion of the rubber contained in the packing, and is independent of the gland. The gland should be set up only with the thumb and finger on this class of packing. A wrench should never be used. This packing is better than the 2 classes just mentioned, since the grip on the rod is not excessive, but it may easily be abused and burned up. It is more economical of steam than the preceding packings.

Fourth: Automatic packing, which depends upon pressure from the cylinder to produce the grip on the

rod, and produces a varying pressure and the least workable pressure, and is the most economical of steam. It is the best type of nonmetallic packing now on the market. It is delicate and can very easily be abused. When put in, a wrench should never be used, but the packing set up easily with the thumb and finger only.

Conditions of Use

We have already classified packings in accordance with the principles on which they work, and we have classified them according to steam economy. Not every packing, however, will serve for every purpose, and it is necessary before we choose our packing to consider the conditions under which the packing is to work. Most rod packing is used for steam, and this again must be classified into low-pressure, average-pressure, and high-pressure steam. For the first class we include steam pressures up to 100 lb.; the second class 100 lb. to about 160 lb.; the third class from 160 lb. upward.

It is difficult to put a dividing line that shall be accurate. With an experienced engineer the dividing line of 160 lb. could be raised to 175 lb. or perhaps higher, whereas, with an inexperienced engineer, the dividing line of 160 lb. should be reduced to 150 lb. at least. This is because some engineers are considerate of the packing, and give it a chance, and others abuse it. Packing in general is like the horse. Some kinds of packing are like draft horses and can be abused and will stand for it, but can only give slow service. Other packings are like race horses, nervous and high-strung, and if pressed too hard will be ruined, but if used properly will give the very best service in the world.

The reason for the classification under steam pressures is due to the temperature involved rather than to the pressure. For low pressures, which means low temperatures, almost any packing can be used. For pressures up to 160 lb., the better class of packings should be used. Rubber and cotton are both vegetable materials and are both used in packings. The temperature corresponding to 160 lb. would be fatal to either of these if they had to stand it for any length of time. But the temperature in the stuffing box is far from the temperature of the live steam, and fibrous packing can be used on engines running under 160 lb. pressure without any difficulty.

The real limit is not the pressure, but the temperature, and if superheated steam is used it is not advisable to use fibrous packing on steam whose temperature runs higher than that which is normal for 160 lb. pressure or thereabouts. It all depends upon the engineer. For packing at higher steam pressures, it is necessary to use some other substance besides organic material, and recourse must be had either to metallic packings or asbestos packings. Almost any form can be used.

Pump Packing

There seems to be an idea that for a pump almost any packing can be used and that the cheaper, the better. This is a mistake. A better packing will last longer anyway, and, far more than this, a pump is in operation all the time and an extra load on the pump consumes steam just as much as if that extra load were utilized in pumping water. A packing of a poorer class adds an extra load. A higher class packing is more economical. It is, therefore, best in every way to use high-grade packing even on pumps.

For the purpose of abbreviation, we will refer to packings according to their principle as 1, 2, 3 and 4.

1. Monkey-wrench packings, dependent on pressure from the gland.

2. Moisture packings, dependent partly on pressure from the gland and partly on moisture.

3. Expansion packings, dependent on heat to expand the rubber cushion.

4. Automatic packings, dependent on pressure from the cylinder.

A packing will be mentioned by number in the order recommended, i. e., the first number will indicate what seems to the writer to be the best packing for that work.

Steam pressures of 100 lb. or less: Use 4, 3, 2, 1.

Steam pressures of 100 lb. to 160 lb.: Use 4 and 3. No. 2 and 1 can be used, but are not so satisfactory. If the steam is superheated these packings recommended may, or may not, be satisfactory, according to the temperature. This is explained in a preceding paragraph.

Steam pressures of 160 lb. and above: Use asbestos packing. Practically all the packings on the market are of the monkey-wrench type.

Valve stem packing: Use same as for piston rod packing, with the exception that the use of asbestos packing should begin at 150 lb. For small sizes, braided asbestos packing proves very satisfactory at any pressure.

Corliss admission valve stems: Use a ring of asbestos at the bottom to protect the other packing.

End-packed plunger pumps: Use 4, 2 and 1.

Inside packed pumps: In the stuffing boxes use 4, 2 and 1. It will be noticed that the expansion packing is omitted for water service, since often there is no heat to produce expansion.

Pump pistons: For an inside packed pump there are really 2 packings now in use. One is a packing made of fine duck, held together with white rubber friction. This is known as a "fine square hydraulic," and is used as a hot or cold water packing. The other packing is similar to this, but the duck is much coarser and the friction is generally made of black rubber. This is known as a "square duck" or a "cold water" packing. The one can be used for either hot or cold water; the other is used for cold water only. There is no particular principle involved here except that the packing must fit snugly.

Where a cylinder has been worn down in the center it is difficult to apply this packing, since when the

piston is brought out to the end of the cylinder there is a smaller space for the insertion of tne packing than there is when the piston is in the center of the cylinder and in position where the packing has to work. For conditions like this it is often found advisable to use diagonal packing, putting in one ring with the cushion toward the end of the cylinder and the wedge next to the cushion touching the cylinder wall, and putting a second ring in, in a reversed position, which will bring the cushion toward the other end of the cylinder and the wedge which touches the cushion also touching the cylinder wall. This can be put in without difficulty when the piston is at the end of the stroke, and when it has reached the center of the cylinder the wedges will, by the pressure, be forced outward and fill in the extra space next to the cylinder, thus making the packing tight.

Air compressors: It is best to use asbestos packing for these, inasmuch as the temperature runs very high upon occasion.

Oil pumps, brine pumps, acid pumps: The same packing should be used as in an ordinary pump with the exception that a packing must be chosen which will not be affected by the liquid. Very often, too, it is necessary to choose a packing, which, if it disintegrates and gets into the liquid, will not cause trouble.

Ammonia: An ammonia box is a special box and works under severe conditions and there is a possibility of extreme change of temperature at short notice. There are 3 common ways of packing an ammonia box. One is to use a packing of class 4. Another is to obtain the same adjustment by the alternate use of a solid and a section ring. Another is the use of a pure rubber ring, taking care that the compound chosen is one that is not easily affected by ammonia. All rubber is affected more or less by ammonia but some compounds are affected almost inappreciably.

The above covers the ordinary conditions. There are, of course, exceptions at almost every plant. There are many cases where a combination of packing of different kinds proves very effective. Of course, the limits of this article prevent going into that with any detail.

THE APPLICATION OF LOW PRESSURE TURBINES TO POWER GENERATION*

By James R. Bibbins

IT is an interesting reflection bearing upon the truth of an old axiom that the commercial retrenchment of the past year has served at least one good purpose—to direct attention to a deserving but unappreciated factor in modern power generation—the low-pressure steam turbine. And curiously enough this approaches more closely in fact than most radical engineering developments to that commercial Utopia, "getting something for nothing." The entire potency of the low-pressure turbine lies in its ability to utilize a waste product, exhaust steam, or so to improve the general

FIG. 1. 2,000-HP. WESTINGHOUSE LOW-PRESSURE STEAM TURBINE ON TEST

*Extract from paper read before the Canadian Society of Civil Engineers, Montreal, Can.

efficiency of a power system as to force a thorough consideration of its possibilities and limitations.

Considering, step by step, the various stages of expansion of steam from the highest boiler pressure to the lowest condenser pressures, it is true that the steam engine finds its most efficient territory in the higher ranges above atmosphere, while the steam turbine works to best advantage in the lower stages. This, of course, does not carry the inference that the engine cannot benefit substantially from high vacuum, nor the turbine from high boiler pressure, for the advantages of each are well known. But it results from the fact

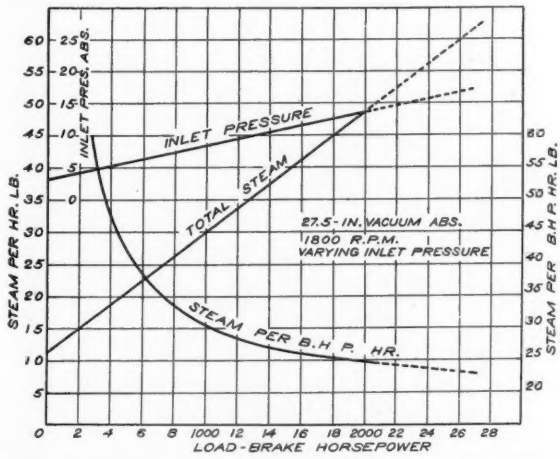


FIG. 2. ECONOMY TEST, WESTINGHOUSE LOW-PRESSURE STEAM TURBINE

that the reciprocating engine utilizes the energy of steam by static pressure, the turbine by its conversion into dynamic force.

In the engine, the losses due to condensation and reevaporation on the cylinder walls during each cycle, are large; in the turbine there is no such change, and therefore no such losses, as there are always a fairly constant temperature and pressure at a given point in the expansion range. In the engine, the mechanical friction of the enormous sizes of cylinders necessary to accommodate the lower expansion ranges, constitutes an effective barrier; in the turbine, the lower ranges are obtained with comparative ease and without incurring excessive losses mechanical or thermal.

A good Corliss engine, although operating condensing, will give the best efficiency, 72 per cent, at normal load in the case discussed later when operating noncondensing, that is, against exhaust pressures of from 15 to 20 lb. absolute. It is understood that the term efficiency in this case refers to efficiency ratio in per cent of Rankin-Clausius cycle; i. e., efficiency in per cent of the available energy in the steam within the range of pressures; it is not efficiency based on steam consumption.

Similarly, the steam turbine expanding from 15 to 25 lb. absolute, will show a maximum efficiency ratio as high as 73 per cent for moderate vacuum. And commercial guarantees are today made above 70 per cent, a fact which speaks for itself. Thus, it occurs that the combination engine turbine plant will show an overall efficiency ratio (65 to 75 per cent of the ideal cycle) considerably in excess of either an engine or complete expansion turbine unit running alone, which can hardly do better than 65 per cent. In the case treated later, the Rankin cycle efficiency of the combined unit was found to be 69.3 per cent at normal load.

Application

There are 2 general classes of service in which the low-pressure turbine finds effective field for application—

Class A: Supply of steam intermittent and widely varying in quantity. For example, (1) rolling mills, for blooms, plate, sheet, wire, rail and structural shapes; (2) steam hammers; (3) hoisting engines. All

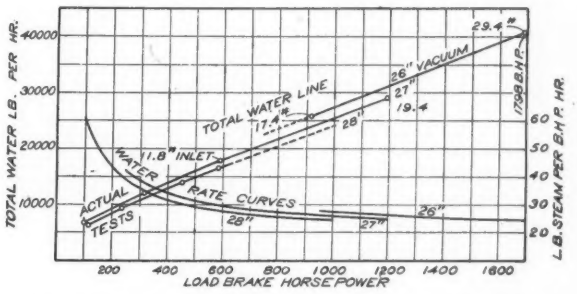


FIG. 3. WATER RATES, LOW-PRESSURE TURBINE TESTS—DRY SATURATED STEAM

of these involve the regenerative principle, requiring a careful study of the time element in supply and demand—generally resolving into a special problem for each individual installation.

Class B: Nonintermittent supply without regeneration. This class embraces central power stations for lighting, traction or for factory drive, and may be discussed as a general problem of power extension where the widely varying plant conditions may be summarized as follows:

(1) Good engine design; fair operating efficiency. Increase in capacity necessary.

(2) Inefficient engines, condensing or noncondensing, improvement in operating economy or increase in capacity necessary.

(3) Present condensing plant unsuitable or inefficient.

(4) Plant location—where water supply is limited, unsuitable or costly e. g., enforced noncondensing operation.

(5) High cost of fuel.

Given a reciprocating engine plant of serviceable construction, along what lines shall needed power extension be made?

(1) By installing more reciprocating units of the same type and operating under the same conditions.

(2) By installing more efficient complete expansion turbines with suitable auxiliaries.

(3) By utilizing the low-pressure turbine principle to render the present plant more efficient.

Primarily, the problem before us is that of Case B (1) and (2) improving the efficiency of a given reciprocating engine plant which may be in the best physical shape but operating under unsuitable conditions.

Turbine Tests

Two series of tests, Figs. 2 and 3 will serve to illustrate the possibilities of economy and capacity:

Figure 2 represents tests at several different loads and varying inlet pressures, all on approximately dry

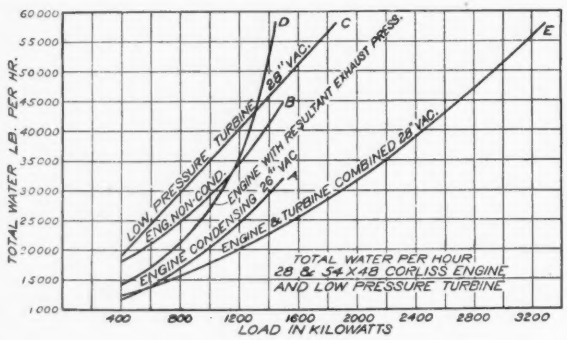

TOTAL WATER LB. PER HR.
LOAD IN KILOWATTS
LOW PRESSURE TURBINE
ENG. NON-COND.
ENGINE CONDENSING 26" VAC.
ENGINE WITH RESULTANT EXHAUST PRESS.
ENGINE & TURBINE COMBINED 28" VAC.
28" VAC.
TOTAL WATER PER HOUR
28 & 54 X 48 CORLISS ENGINE
AND LOW PRESSURE TURBINE

FIG. 4. WATER LINES OF CORLISS ENGINE AND LOW-PRESSURE TURBINE

saturated steam and 27.5 in. vacuum. Although a few of the original observations were slightly irrational, this was due to the difficulty of maintaining exact vacuum, and when corrected fell well into line. Note that these tests, Fig. 2, were all conducted at inlet pressures below atmosphere, but the characteristic for higher pressures is the same, a straight line, as has been proven by other tests carried as high as 30 lb. absolute pressure.

The effect of higher inlet pressures and varying vacuum is well shown by Fig. 3, a series of tests upon the low-pressure section of a 2000 hp. lighting turbine. This machine is of the single flow design, the high-pressure section expanding down to about atmosphere and the low-pressure section below. The water lines are virtually straight up to the maximum initial pressure 30 lb. and slightly divergent for varying vacuum.

Characteristics of Low Pressure Turbine

From a thermodynamic standpoint, the low-pressure turbine is the exact counterpart of the complete expansion turbine with which we are all familiar, and it possesses the same characteristics shown by Fig. 3. As in the high-pressure turbine, the line of total consumption an hour, or water line, is practically straight, resulting in a constantly decreasing water rate curve. The power developed by this machine, increased in proportion to the inlet pressure, barring the small friction drop throughout the machine at no load.

Engine Characteristics

Assuming a normal design of Corliss compound engine, there are 2 methods of governing which may come under consideration:

(a) High-pressure cutoff variable; low-pressure fixed.

(b) Parallel cutoff; i. e., both high-pressure and low-pressure variable in the same direction, increasing with the load.

The parallel system is widely employed in Corliss practice to maintain an equalization of work in the 2 cylinders. It is difficult, however, to avoid loops in

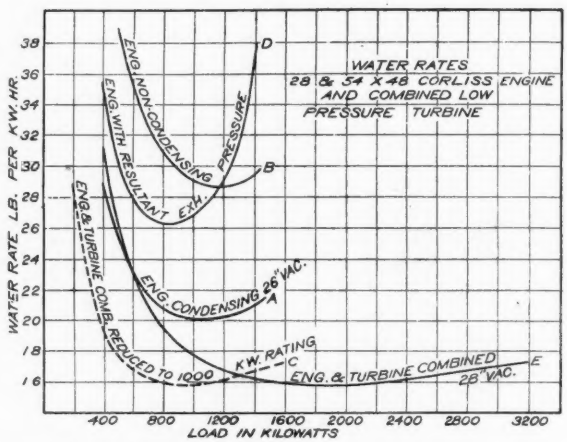

WATER RATE LB. PER KW. HR.
LOAD IN KILOWATTS
WATER RATES
28 & 54 X 48 CORLISS ENGINE
AND COMBINED LOW
PRESSURE TURBINE
ENG. NON-CONDENSING
ENG. WITH RESULTANT EXH. PRESSURE
ENG. & TURBINE COMB. REDUCED TO 1000 KW. RATING
ENG. CONDENSING 26" VAC.
ENG. & TURBINE COMBINED
28" VAC.

FIG. 5. WATER RATE CURVES OF CORLISS ENGINE AND LOW-PRESSURE TURBINE

the low-pressure cards at light loads, noncondensing, as the low-pressure cylinder expands below the exhaust pressure. In case (a) the low-pressure cutoff is deliberately fixed far enough in advance to eliminate the low-pressure loop in the lower ranges of loads anticipated. But this system has the disadvantage of causing a great disparity in loading of the cylinders. Thus with low-pressure cutoff fixed at 75 per cent of stroke and the high-pressure as short as 15 per cent, the engine would deliver steam to the turbine at 8 lb. absolute and without loop. But on maximum load with high-pressure cutoff at 75 per cent and 25 lb. back pressure, the ratio of work in the 2 cylinders would be about 2 to 1.

Combined Plant

The effect of the various factors above outlined may be best illustrated from Fig. 4 and 5 which have been prepared to exemplify the principles of design for a 2000-kw. installation suited to a 50 per cent overload, or thereabouts. Figure 4 shows only the water lines, from which are derived the respective water rate curves, Fig. 5. These water lines cover the following conditions:—(A) Engine alone condensing, 26 in. vacuum. (B) Engine alone noncondensing, 17 lb. absolute back pressure. (C) Low-pressure turbine alone, 28 in. vacuum, variable inlet pressure. (D) Engine noncondensing with variable back pressure, resulting from its connection to the turbine. (E) Combined engine and turbine system, 28 in. vacuum.

Of the above, (A), (B), and (C) were obtained by

actual data. The combined curve (D) must be found graphically from the characteristic curves of engine and turbine, and the final curve (E) by combining (C) and (D). These water lines, Fig. 4, serve to illustrate the difference between the Williams characteristic for turbine (C) and an engine (A) (B) governed by cutoff. One is a straight line, the other a curve. The turbine has no point of lowest water rate other than maximum load; the engine ordinarily does its best at rating or under.

It is usual practice to rate an engine at its point of lowest steam consumption. This may be found from the water lines as the point of tangency of a radial line from the origin. Thus, this engine running condensing shows its best economy at about 1000 kw., and noncondensing, at about 1200 kw. which is entirely rational. On the other hand, the resultant engine curve (D) shows a best point of economy slightly under 900 kw., due to the influence of the variable back pressure. Examining the water rate curves Fig. 5, we find that the engine gives an economy of 20.05 lb. a kilowatt-hour condensing, 28.31 lb. a kilowatt-hour noncondensing, for a normal load of 1000 kw. in each case; but in combination with the turbine, a maximum water rate of 15.8 lb. a kilowatt-hour.

Curve (C) Fig. 5 has been derived from (E) for comparison of water rates of combined plant and condensing engine on the same basis of rating; i. e., equivalent to curve (E) at half scale. Thus, at rating, the combined plant shows an improvement of 22 per cent in water rate. At light loads, however, 500 kw., the combined plant ceases to be as efficient as the engine running alone condensing. The point of equal economy is, of course, somewhat variable, as it is difficult to locate it accurately with 2 curves at such an acute angle; but it immediately suggests that in the practical operation of a combined plant, it would be desirable to shut down the low-pressure turbine when the load falls below 30 per cent rating, for example, and operate the engine alone.

Governing

For a study of governing, the various classes of service may be summarized as follows:

Class A: Turbine electrically locked with engine; that is, serving the same bus bars.

(1) Turbine taking all of the engine steam. No governor required. Load on turbine varies with engine load.

(2) Turbine taking part of the engine steam. No governor required. Output remains practically constant with uniform pressure in exhaust mains due to excess supply of exhaust steam. In both of the above cases the atmospheric relief should be provided, if only to enable the engine to operate while the turbine is shut down, and of course a hand throttle valve.

Class B: Turbine electrically independent of the engine, that is serving separate bus as for lighting only with the engines on a traction bus.

(3) Turbine taking all or part of the engine steam. Governor required in case of intermittent supply.

In all of these cases a safety stop is obviously essential, simply for insurance against possible overspeeding. In Class A (2), for example, should the circuit open with the turbine under load, the safety alone would prevent disaster. The automatic safety stop may operate either a butterfly valve or a positive closing throttle.

Gary Installations

A typical example of low pressure turbine application is found in the plant of the U. S. Coal & Coke Co., Gary, W. Va. It operates the mining property, serving hoists, pumps, blowers, lights, etc. The plant contains 2 24 by 44 by 42 in. Corliss engines, driving 750-kw. generators; one 1,000-kw. complete-expansion steam turbine and a 1,000-kw. low-pressure steam turbine, both of the Parsons type. These turbines are served by 3 cooling tower units, fan-driven, each 24 ft. in diameter and 25 ft. high. Two of these units serve the low-pressure turbine and one the high-pressure turbine. The following figures roughly indicate the normal operation of the generating units from readings taken Oct. 7, 1908:

Output of 2 Corliss engines	1,400	kw.
Output of low-pressure turbine	1,200	kw.
Steam pressure (gage)	150	lb.
Vacuum, l. p. turbine (rfd. to 30 in.)	25.8	in.
Temperature of injection	88	deg.
Temperature of air	85	deg.
Cooling in tower	31	deg.

Thus the low pressure turbine carried nearly half the total load on less than 26 in. vacuum, and would have carried over 1,500 kw. on 28 in. vacuum with better condensing conditions.

Auxiliaries

Inasmuch as the turbine is so dependent upon auxiliaries, it is pertinent to point out some facts in this regard. If we compare the ideal water rate of a turbine expanding from atmosphere down to various vacuums, we shall find that while the ideal machine improves continuously down to the lowest condenser pressures, the actual turbine cannot make as good use of the last inch or 2 of vacuum, as in other parts of the expansion range; in other words, we may expect the highest efficiency in moderate ranges of vacuum.

A good surface condenser should operate at least within 15 deg. difference between the temperature of the steam and discharge water; a good barometric jet, within 10 deg., yet we find that twice this difference is tolerated in modern power plants as supposedly good performance.

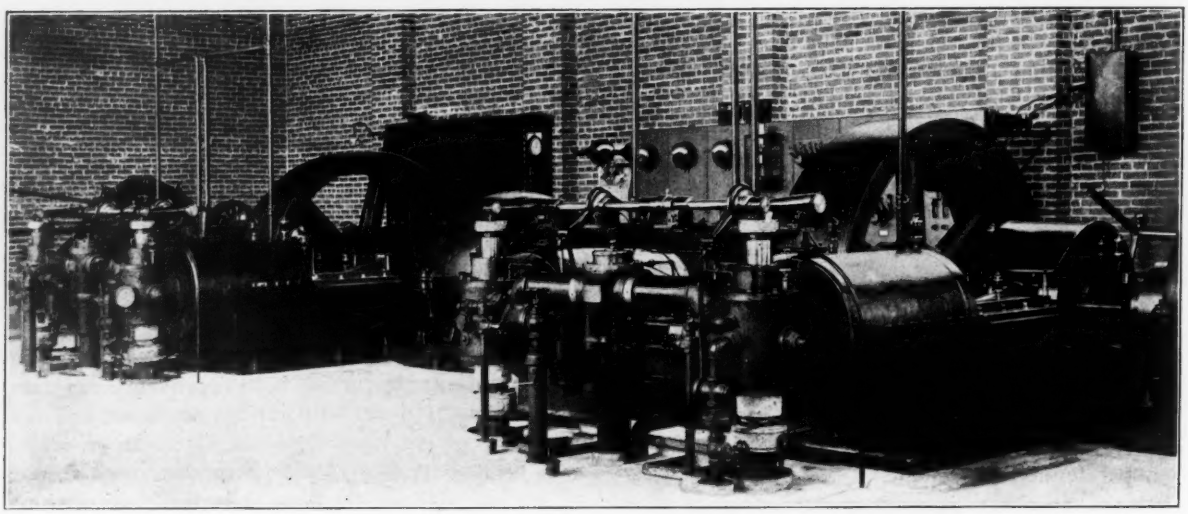
The more efficient jet type is responsible for reducing the quantity of cooling water to ⅛ that required quired for the average surface type. In cooling tower practice, where extra power is required to lift these large volumes, this is evidently of the highest importance, for the increase in auxiliary plant may more than offset the benefits of the increased vacuum.

GAS ENGINES AND PRODUCERS

FOUR-CYCLE GASOLINE ENGINE

By A. Edward Rhodes

IN THE March, 1908, issue of Practical Engineer I stated that the inlet and exhaust valves are actuated by cams which in turn are rotated by the crank shaft. By referring to the illustration Fig. 1 it will be seen that these valves 10 and 11 are controlled by cams 14 and 15 on the 2 lateral shafts 1 and 2, which are rotated by the crank shaft through the gears 3, 4, and 5. As each valve opens but once each 2 revolutions of the crank shaft, the lateral shafts 1 and 2 must revolve but once for each 2 revolutions of the crank shaft. For this reason the gears 4 and 5 are twice the diameter of the gear 3, and the ratio of the gearing is 2 to 1. It is evident that the cams 14 and 15 on the lateral shafts 1 and 2 striking the lower ends of their respective valve stems will raise the valve from its seat for admission or exhaust, as the case may be.



MILLER IMPROVED GAS ENGINES IN THE PLANT OF THE SPRINGFIELD METALLIC CASKET CO.

6 is the admission chamber opening into the combustion chamber 7, which in the illustration forms part of the working cylinder. The vaporizer described in the August issue is connected to 8.

The exhaust chamber 9 is a duplicate of the admission chamber. 10 is the admission valve, and 11 is the exhaust valve, these valves having stems 12 and 13 extending down to a point where they can be raised by the square sliding bars carrying the friction rollers 18 and 19, and sliding up and down in the bearings 16 and 17. The springs 22 and 23 return the valves to their seats and hold them there except at such times as the cams lift the valve stem through the friction rollers 18 and 19. 24 is the sparking device for igniting the admitted gas at the proper moment.

It is evident that the suction of the piston on its down (suction) stroke will have a tendency to raise the admission valve 10 and admit the gas from the chamber 6. In fact, just as soon as the suction in the cylinder becomes greater than the force that seats the valve, the valve will open for admission regardless of the cam 14. Therefore it is evident that it is not absolutely necessary that the admission valve be mechanically operated, and that it may be operated by the suction of the piston. The conditions controlling the exhaust valve are different; here the valve is opened (raised) against the pressure in the cylinder, and therefore the exhaust valve must be mechanically operated.

Figure 2 shows an engine in which the above arrangement is adopted. The admission valve 10 is shown inverted, and is held on the seat at all times, except during admission, by the spring 22 assisted by the pressure in the cylinder. By this arrangement one lateral or cam shaft and its accompanying mechanism are dispensed with. Of course, the valves may be on either or both sides of the engine, or on the head of the cylinder, which may be of the same casting as the cylinder or separate as is frequently done.

There is a difference of opinion as to whether both valves should be mechanically operated. The question is argued both ways, builders being about equally divided in their practice. I believe it is generally

agreed that for slow or medium rotative speed engines the suction admission valve gives satisfactory results, and for the higher rotative speeds the mechanically operated admission valve is to be preferred as it is quicker and more regular in action. It is advisable to have a counterweight 25 on the crank shaft to balance the moving parts for reducing the vibrations; especially is this to be desired for single cylinder engines.

AN INTERESTING GAS ENGINE PLANT

In the factory of the Springfield, O., Metallic Casket Co. there have been running for more than a year, 10 hr. every working day, a pair of gas engines driving electric generators. The engines are rated at 150 hp. with 25 per cent overload capacity and at a speed of 200 r. p. m. These engines were furnished and installed by the Miller Improved Gas Engine Co., of Springfield, and are direct connected to Sprague Electric Co.'s generators of 100 kw. capacity each, furnishing direct current at 250 volts. The units work in parallel with each other and with a steam driven unit of about the same capacity.

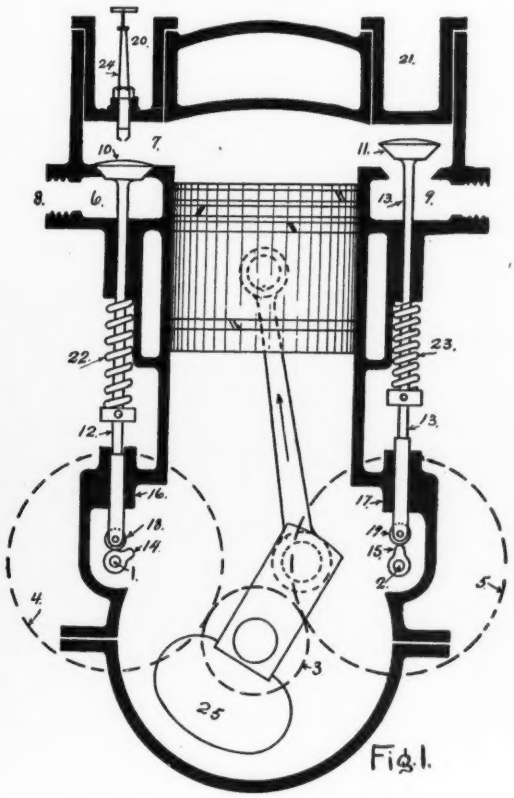


FIG. 1. GAS ENGINE WITH CAM-CONTROLLED VALVES

Power from these generators is used to operate machinery in the factory and to furnish lights. The owners of the plant speak of it as very successful and giving the best of satisfaction.

INERTIA IS THE arch foe of success.

TO KEEP THE ENGINE RUNNING

WHEN a combustion engine gets sick there are certain places which, if looked after, will usually reveal the seat of the difficulty. Of course, there are some instances where none of the probable things is the cause of the trouble, but it is worth while looking first for the usual difficulties before settling down to the idea that it "just won't go." One of the most fruitful causes of trouble is the ignition circuit, not because there is any reason for its making trouble but because it is generally neglected.

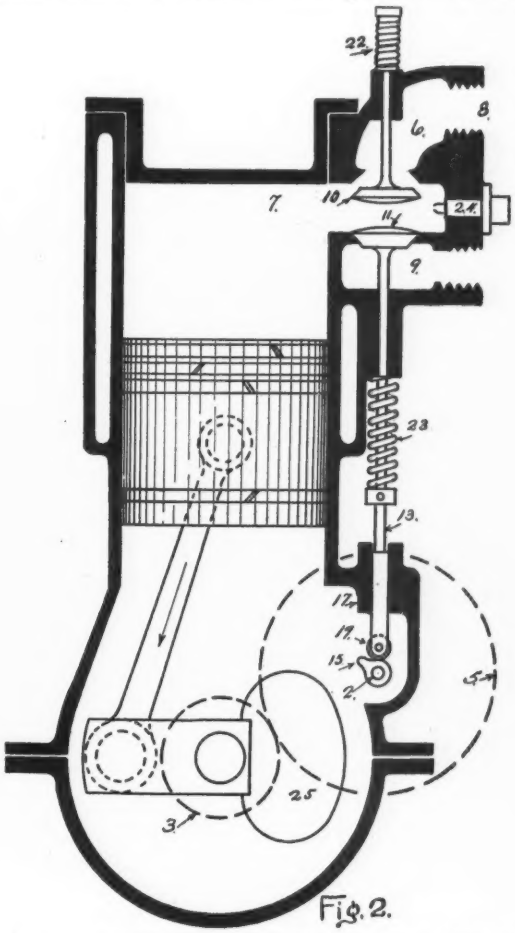


FIG. 2. GAS ENGINE WITH AUTOMATIC INLET AND CAM-OPERATED OUTLET VALVE

The essential parts of an ignition apparatus are the spark coil or magneto, the timer, the spark plug and the battery or dynamo. In the case of the make and break spark, the spark coil may be omitted. When magneto current is used the time of closure of the make and break circuit is not of so much importance as this has only the effect of using somewhat more energy than usual. If, however, battery is used as the source of current, keeping the contact closed longer than necessary results in running down the battery rapidly.

Battery Connection

The National Carbon Co. from whose booklet this

article is largely taken has made experiments to determine the best form of battery for use in ignition circuits and has determined that instead of using, as is often done, 5 or 6 cells connected in series, which gives a high voltage but not sufficient current capacity, the best form of connection is 4 cells in series and enough of these series put in parallel to give the amount of current required. They have found that when a spark coil is properly adjusted it should not draw more than 0.3 to 0.5 ampere and that the time of contact should be sufficient to give only a single spark of sufficient heat to ignite the mixture in the cylinder. They recommend that for a single-cylinder engine 2 sets of batteries, 4 in series in each set should be used, for 2 or 3 cylinders 3 sets, and for 4 or more cylinders 4 sets.

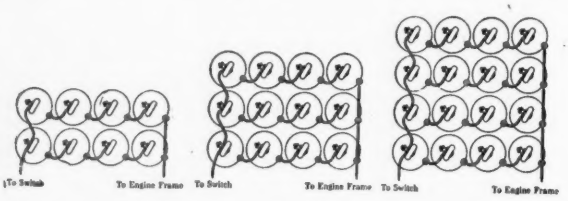


FIG. 1. SERIES MULTIPLE ARRANGEMENTS OF CELLS FOR IGNITION CIRCUIT BATTERIES

Adjusting the Spark Coil

In adjusting the spark coil, the engine should be turned over while the machinery is not running until one of the spark coil units is thrown into position in the battery circuit and its vibrator set in motion. This vibrator has an adjusting screw and set nut, and the adjusting screw should be backed off until the contacts are separated and the vibrator ceases to work. The adjusting screw should then be set forward, increasing the tension just enough to cause the vibrator to start in motion and the set nut then secured.

In like manner the tension of the vibrator for each of the spark coils on a multiple cylinder engine should be adjusted and this will give the minimum consumption of energy in the ignition circuit. Now, if the engine is started up and refuses to run, or if it runs irregularly, the tension on each vibrator should be increased by giving the adjusting screw a slight forward turn, making this increase as slight, however, as can be had and still have the engine run regularly.

Finding the Ignition Fault

When an engine stops suddenly and will not start or misses fire, the best method of procedure is to turn it slowly to see whether each section of the spark coil buzzes. If all do buzz, it proves that the trouble is not in the batteries, timer, vibrator, or connections in the circuits.

The next move is to take out a spark plug, reconnect the wire and lay it where the threads of the plug touch the metal of the engine but where the top of the plug cannot touch the metal; turn the engine over until the vibrator begins to buzz. If you get a good spark at the plug, it is all right. Repeat this for each plug on the engine and if everything works all right there should be no ignition troubles.

Sometimes the vibrator will not buzz. This comes from 2 general causes, either a broken circuit or a poor contact. The broken circuit may be from a disconnected ground wire which runs from the coil to the engine, or from disconnected or broken wire in the battery circuit, and here the break may be inside the insulation of the wire. It should be felt carefully along its whole length.

Bad contact comes, of course, either in the timer or in the vibrator, and the remedy is to clean the contacts. Sometimes if the vibrator points get gummed up they may stick; this again is due to dirty points. If the circuit shows none of these faults, it is possible that the batteries, if it is a battery system, have run down, and these should be tested by a pocket ammeter to ascertain whether they are in good condition.

If one of the vibrator sections does not buzz the trouble is located in that section of the spark coil or wiring; either the contact point is dirty or the wire from that section of the coil to the buzzer is broken, or there is an internal defect in that section of the coil. Replacing the section that does not buzz by one that does will tell whether the trouble is in the section itself or not. If all the sections buzz but there is no spark in any plug, the trouble is almost certainly in the ground wire from the high tension side of the coil.

If there is a spark from one or more plugs but not from the others, the trouble is probably either loose connections between the high tension side of the spark coil and the plug, or a defective spark plug. The defect may be due to the breaking down of the insulation and sometimes this is partially broken down so that the spark seems all right in air but will not carry inside the cylinder where it must force current through a mixture under compression. If the spark plug seems all right, the trouble may be due to defective insulation from moisture, oil or a short circuit.

If the engine persists in missing explosions, although the battery seems all right, it may be because the gas is too poor, or because, if a gasoline engine, the mixture is too rich, or because of loose connections in the wiring, or because the valves of the engine are leaking.

Directory of Engine Troubles

Some of the most common difficulties encountered with an engine and possible causes are irregular firing, which may be caused by broken down insulation of the wires, an improper mixture of air and gas, a cracked spark plug, a gas fitting partly stopped off, moisture on the spark plugs, or water in the oil case, poor contact of the timer, bad adjustment of the spark coil, or loose terminals on the coil. Many of these troubles can be avoided by seeing that the wiring is always kept in good condition and by keeping things clean.

If the engine emits a hissing sound, the difficulty

may be a broken spark plug, a cracked exhaust pipe, an open compression cock or a loose joint between the exhaust pipe and the muffler.

If the engine fires regularly but is weak, the difficulty may be caused by improper gas mixture, by lack of oil, by dirty platinum points of the spark coil, by insufficient compression due to leaky valves, by too low a lift on the exhaust valve, causing incomplete scavenging, or by weak spring on the inlet valve.

When an engine refuses to start, it may be because of broken or jammed gears, dry cylinders, a battery plug out of place, a dirty or cracked spark plug, lack of fuel, improper mixture of gas, an inlet valve stuck, an open battery switch, insufficient compression, or water getting into the cylinder either through a leak

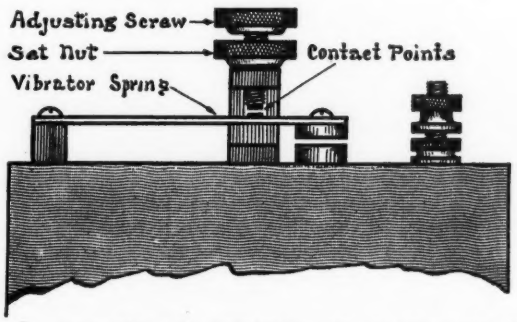


FIG. 2. VIBRATOR ARRANGEMENT FOR JUMP-SPARK COIL

in the water jacket or with the gasoline in the case of a gasoline engine. A recent experience in Northern Wisconsin of one of the prominent gas engine builders showed that throughout a considerable section water in the gasoline sold by different dealers was making trouble. When this trouble was removed the engines ran all right.

When an engine has been running but stops suddenly, the probable troubles are a broken spark plug, a break in the wiring of the electrical circuit, or a wire loosened from the terminals, a stuck vibrator on the spark coil, trouble in the timer or failure of the fuel supply.

When an engine slows up gradually, it is likely to be caused by dirty inlet valves or fouled spark plugs.

If there is back firing in the exhaust to the engine, the trouble is usually because the cylinder is missing fire so that explosive mixture is being thrown into the exhaust and ignited from the heat of the next exhausted charge, or the exhaust valve does not seat properly, or the spark is too late or too weak, or the gas mixture in the cylinder is too weak to explode.

Knocking in the engine is, of course, due to loose bearings at some point. It may be caused by poor lubrication, a flywheel loose on the shaft, a loose joint somewhere through the frame of the engine, loose bearings, too rich a mixture or the spark too early.

EIGHT POUNDS OF WATER evaporated per pound of coal is an average performance.

NATIONAL GAS ENGINE TRADES ASSOCIATION MEETING

THOSE who were fortunate enough to be in attendance at the second meeting of the National Gas Engine Trades Association at the Auditorium Hotel, Feb. 9, are fully convinced of the usefulness of the association and of the great possibilities it has for benefiting its members. Not only was the need of co-operation among builders of combustion engines and gas producers clearly shown but many matters of mutual interest were brought up by the interesting papers read and a great amount of information given in the discussions which followed.

The meeting was called to order by Secretary Harry T. Wilson and after the secretary's report of the previous meeting and the treasurer's report showing a substantial balance in the treasury, President Wilson spoke as to the needs of the association and invited the expression of ideas as to what might best be the functions of such an association. Several suggestions were made by different members, the most important being that papers should be presented and discussed, that methods of educating the public to the possibilities and desirability of the gas engine should be prepared and pushed, that a question box for bringing up difficulties should be started, that exhibits of gas engine construction and accessories should be held at the meetings, that committees should be established to take care of different subjects of interest to members, all of which committees should meet separately and report to the general association, that steps should be taken to overcome the public prejudice against gas engines which has resulted from unwise action by some makers in the early days of engine development.

Means proposed for carrying out these ends were the publication of pamphlets of instruction showing how to take care of engines and how to overcome difficulties which might be encountered in running them, the holding of schools of instruction at different points, the presentation of the needs of the gas engine industry in trade papers, and to the different engineering schools, and the training of salesmen and representatives of gas engine makers who meet the general public so that they themselves will fully understand the engines which they are selling and handling. The papers presented at the meeting will be given in a later issue.

The executive committee reported at the afternoon session that committees would be appointed on producer gas engines, on industrial gas and gasoline engines, on farm engines, on fuel, on entertainment, on publicity, on ignition circuits and machinery, on general accessories, on automobile and marine engines, on membership, and on traffic regulations.

Invitation extended to the society by South Bend, Ind., through Treasurer Otto M. Knoblock to hold a meeting there was accepted and the date of the meeting appointed as June 22 next.

UNIVERSITY TESTS GAS

The department of chemical engineering at the University of Wisconsin, in charge of Professor Charles F. Burgess, has been carrying on an extensive series of tests of the various methods for measuring the heating values of gas, in order to enable the State Railroad commission to determine a standard gas for fuel and illuminating purposes. The calorimeters of various types made both in this country and abroad, and used to test the heating values of gas have been thoroughly tested. It was discovered that one type of instrument extensively used and sold gave heating values from 10 to 20 per cent higher than the gases measured actually contained, and that erroneous results were being obtained in gas producer and gas engine work where these instruments were found in use.

One of the most marked defects in the calorimeter outfits was found due to inaccurate thermometers. The various users of gas calorimeters in Wisconsin may have these defects remedied by the university experts. The department of chemical engineering has just made the announcement that it is in a position to calibrate accurately such calorimeter thermometers as may be sent to it by users in Wisconsin. The State Railroad commission, through the co-operation of this department, offers this service free of charge to public service companies in this state.

Investigation work along this line is to be continued, and the chemical engineering department is co-operating with the railroad commission and the committee of the American Gas Institute in prosecuting this research work. Not only are the properties of gaseous fuels being studied at the university laboratories, but solid and liquid fuels are also receiving attention.

Wisconsin has the record of being the first state to prescribe a heating value as the standard for gas for fuel and illuminating purposes. Investigation showed that over 90 per cent of the gas is used for the heat that it is capable of developing. The old candlepower standard is therefore wholly inadequate. It is predicted that the universal standard of the future will be that based upon the heat unit. A recent report of the Public Utility commission of New York suggests that an investigation is under way looking toward a change of standard in that state.

Professor Burgess has been assisted in his work by Professors J. L. Dickerman and O. L. Kowalke, in co-operation with a committee appointed by the American Gas Institute, consisting of R. B. Brown, of Milwaukee; J. B. Klump, of Philadelphia, and Professor Burgess.

WOOD PIPES

Wood pipes made from full sized logs have been in use for many years both in European countries and in the United States. The water supply of many of the older cities on the Atlantic Coast was formerly distributed entirely through such pipes. In numerous instances they have served for many years, and occasionally at the present time such pipes are dug up in the course of modern improvements and are found to be in a very good state of preservation. In several instances such pipes are still in use after a service extending over a period of 50 or 75 years. At Fayetteville, N. C., a line of 2 miles of wood pipe was laid in 1829; it is sound and in constant use at the present time. A large wood stave pipe which supplies the pumps of the city water works of Manchester, N. H., was laid in 1874 and is said to have caused no trouble and has not been disturbed since.

The pioneers of the Atlantic Coast used wood pipes made by boring a hole lengthwise through a full-sized log. The pioneers of the Pacific Coast use wood for pipes also and with greater economy because of the advantages gained by virtue of past experience and modern manufacturing methods. Today wood pipes are made of staves so manufactured as to give a cylindrical shape which is absolutely uniform and waterproof. The pipes of small size, up to 2 ft. in diameter, are made from staves of special pattern with grooved edges and are built up in the factory. The pipe is wound from end to end with steel wire and coated with a mixture of asphalt and tar for preservative purposes. The thickness of the staves and the pitch of the winding vary according to the pressure under which the pipe is to be used. Large pipe over 2 ft. in diameter is generally built up at the point where it is to be used, the staves being placed so as to break joints. These staves are made 6 in. wide and are shaped with plain, bevel edges, and a curvature to conform to the diameter of the pipe. Special patented bands girdle the pipe and are drawn up tight so as to close all joints.

It is a well-known fact that timber saturated with water and protected from outside influences is practically everlasting, and, therefore, if an underground wood pipe runs full of water for sufficient intervals to insure complete saturation of the wood, aided by the water pressure, the life of the pipe is greatly increased. When used above ground in contact with the air, under the above conditions, the time of service of wood varies with climatic conditions. Ordinarily, however, the life can be estimated at from 40 to 50 years. Manufacturers of wood stave pipes point out the following advantages of their product over the more commonly used cast-iron and steel pipes for water distributing systems:

Wood pipes are equal in durability to those made from cast iron, and 4 times more durable than steel.

Wood pipe costs ¼ as much as cast iron and ½ as much as steel. It is much more easily handled and requires less labor to lay. It is easier to tap for connections.

Wood pipe has greater discharging capacity than cast iron or steel. The inner surface of wood pipes becomes smooth with use, whereas iron becomes covered with large tubercles.

Wood pipes are not affected by electrolysis, while cast-iron and steel pipes are often entirely destroyed.

Wood is a poor conductor of heat. The water flowing in a wood pipe is kept cooler in summer and warmer

in winter. Water freezing in iron pipes causes them to burst; wood will expand sufficiently to avoid this result.

MEASURING THE RESULTS OF ADVERTISING.

If advertising operated like a machine, using specific material and running at known rate of speed, the quality and quantity of output might be easily determined. The results of advertising are, however, subtle and elusive. That as a general proposition advertising pays, no one will dispute, else we must admit ourselves a nation of fools. But the ultimate value of advertising no one can estimate, for the power of publicity transcends all bounds.

Certain definite and direct returns we see and measure, certain effects we know to have been produced—though we feel their force we cannot determine its magnitude, but extending far beyond these are influences varied in their extent and character and cumulative with the passage of time that must forever remain unknown. What we can see and determine we must accept as some measure of the total results of advertising. If measurable returns do not appear satisfactory we must consider the conditions, if need be improve our product and our methods, but above all decide whether our advertising policy is to be determined solely by such returns, or be based upon a larger foundation of which common sense shall be the corner stone.

Fundamentally advertising must be done on faith—not blind, ignorant and unreasoning—but intelligent, abounding faith in advertising as an indispensable factor in business success—faith in the evidence of things not seen.

Detailed study of specific methods is essential and helpful, but it must always be undertaken and the results analyzed in the light of a clear understanding of all the conditions. If a given expenditure in circular letters and return stamped envelopes brings more traceable results than an equal amount expended in trade paper advertising, we must not at once adopt the former as the only method to be followed. A high-grade publication which shows but a few traceable replies is not to be condemned because another publication of manifestly lower editorial quality brings a greater number. The character of the readers and of the article advertised, the circulation of the papers and many other factors must be taken in consideration.

Slowly or quickly, as the case may be, publicity becomes a more or less tangible asset whose established value is dependent upon many factors. It is an element in the "goodwill" of a going concern. As an immediate estate is created through life insurance, as a business may be quickly established and trade insured through immediate and extensive but judicious advertising. But business and reputation so created must be founded on quality. Then and then only does the asset created by publicity become of real value and permanency. It has been well said that while we charge off depreciation we should charge on publicity.

The cumulative effect of advertising is its greatest possession; it is not merely sufficient unto the day thereof, but its influence spreads beyond the limits of our time and knowledge. It is well, then, that it should be done with all the ability available, that no pains should be spared to make it perfect, for only this way can the advertising problem be solved with a reasonable degree of accuracy.—From an article in the *Selling Magazine,* by Walter B. Snow, Publicity Engineer, Boston, Mass.

ROPE VS. BELT DRIVES

Speaking at first hand from extended experience, John H. Damon, of the Plymouth Cordage Co., gives in a recent article an interesting comparison of costs between rope and belt drives. He asserts: "First, that rope drives are many times installed where nothing else is feasible; second, that the care of rope is not generally in hands so experienced in its needs as is the belt, which results thirdly, in overlooking the care required to keep belts in proper order, but makes very noticeable the attention demanded by the rope. In other words, the average mill man is blind to the fact that his belt stretches during its life nearly as much as the rope, that it has to be respliced; that it fails under load, and so on; all of which facts come very prominently before his eyes in the case of a rope when it calls for some of his care.

"Accepting the figures of 5 per cent of first cost in maintenance of an ideal belt drive, we will use 8 per cent of first cost in maintenance of a parallel rope drive. That is, one run under fair conditions and installed with low cost of maintenance as an important objective.

"The first cost of the leather-belt drive as a whole would be, for, say, a 500-hp. drive, with approximately 50-ft. centers, about $1,270, for the rope drive about $850. Now the per cent cost of maintenance should not be from these figures, but from the cost of the belt or rope. Let 6 per cent be charged off each drive for fixed charges of pulleys and sheaves; this would equal, at first cost of belt pulleys of $375, $22 for the belt, and at a first cost of rope sheaves of $610, $37 for the rope. The first cost of the belt on such a drive would be approximately $895, and that of the rope some $250. The maintenance of the belt, at 5 per cent, would be $45 annually, and for the rope, at 8 per cent $20 annually, making a total annual cost of $67 for the belt, and for the rope $57. These figures, if the distance of centers is reduced, would become more favorable to the belting, or if extended would favor the rope, but, as already mentioned, may be predetermined for any installation. The scrap value of rope is a very considerably higher per cent of the first cost of the rope than is that of leather to its first cost, being about 15 per cent, while that of leather is about 10 per cent.

INCREASING THE ANGULAR ADVANCE of an eccentric increases the lead of the valve, brings admissions and cutoff earlier.

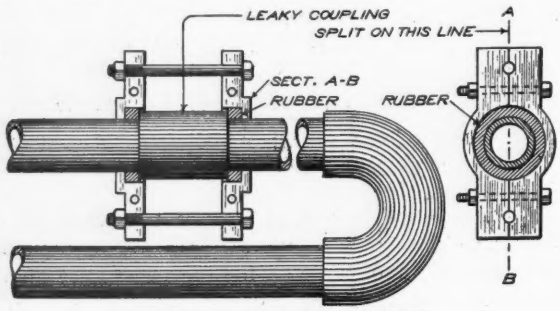
REFRIGERATION

LOCATING DEFECTS AND EMERGENCY REMEDIES

By William S. Luckenbach

AMONG the first duties of the engineer at the beginning of his watch is to go carefully over the entire plant, taking notes of the various temperatures and comparing with the standard temperatures at which the best results are obtained. The importance of maintaining these temperatures has been explained in the November issue, under the title of Thermometers. This daily routine is not complete without testing for ammonia leaks in the bath, waste water from the absorber, condensing and cooling coils, also the distilled water.

A leak in one of the bath or expansion coils is one of the most difficult to locate and repair, one method is as follows: First stop the agitator, then test the brine at various points in the freezing tank, being careful to use the same number of drops of the solution to the same quantity of brine; should any of the brine show a higher color, it indicates that the leak is in that locality. Now look along the coils for bubbles,



REPAIR CLIP FOR LEAKY JOINT

and the appearance of them on the surface indicates the leak, then pass the hand down the pipes until the leak can be felt by the sensation, first coating the hand and arm with stiff grease to protect it from the cold brine.

Next, take an ordinary wagon clip and bend it to suit the circumference of the pipe, allowing for a soft rubber sheet packing; clamp this to the pipe. If this cannot be done, the coil must be cut out, the method of doing this having been explained in the November issue under the title, Freezing Tank and Expansion Coils. A leak in the atmospheric condensing coils can easily be detected by the formation of a whitish substance on the pipe which soon forms a crust. It can be repaired in the manner described above. Should the leak be at a socket or return bend a double split clamp, as shown in the illustration, with one ring of ⅜ or ½ in. square pure rubber cut to fit the recess neatly, will stop the leak effectually without any strain on the threads.

This same style of split clamp can be used on any fitting, and the writer always keeps several sizes ready for an emergency including a clamp for the back of a fitting. They are made of grey iron and are not expensive after once having the pattern made.

Absorber

If the waste water pipe from the absorber shows a leak, there is only one remedy, viz., cutting the coil out of service; keep the others as clean as possible and force more water through the remaining coils in order to maintain the same temperature in the absorber and also try to reduce the temperature of the poor liquor for the same purpose.

Sometimes when standing in front of the absorber glass one will see what appears to be a whitish liquid flowing from the bottom to the top of the glass, indicating a fictitious liquor level. Upon close examination, it will be found that there are a multiplicity of small air bubbles and noncondensible gases from the expansion coils, which condition is very much accelerated by the temperature of the absorber being higher than normal. The remedy is to burn off all you can and to decrease the temperature of the poor liquor entering the absorber. A very good plan is to place an expansion or purge valve at the highest point on the high pressure system, usually the condensing coils, and by having an attendant at this valve when charging or starting up after a shutdown, much annoyance will be avoided later on.

Should there be a scarcity of liquor in the absorber, it is due to some obstruction in the poor liquor pipe, usually the perforated spray pipe. The remedy is to form a partial vacuum and open the poor liquor valve wide for a few seconds, thereby blowing the clogged mass through the perforations, at the same time noting the absorber pressure as it may not be built to withstand the full generator pressure. If this does not clear it, make a bypass if possible, otherwise the machine must be shut down and the spray pipe removed and cleaned. The writer, however, has never known this to occur where the spray pipe was thoroughly cleaned every season. As a precautionary measure, open the poor liquor valve wide a few seconds, say twice a month; this will keep the perforations open at all times.

Ammonia Pump

The valves and plunger should be in first class condition at all times. Should either of them fail, and there be no reserve pump, there is no remedy but to shut down and fix it. Should the rod, however, get worn and no new one be at hand it can be run without much leakage by using an elastic packing such as rubber rings with a tuck packing ring at the bottom of the

stuffing-box and 1 ring next to the gland, all to fit neatly and be lubricated. Should the pump fail to supply the proper quantity at times, it is most likely due to being air or gas bound, which can sometimes be remedied by external application of ice to reduce the temperature, or removing the valve caps, filling the spaces with distilled water and starting up quickly. The permanent remedy is to reduce the clearance between the plunger and the valves to a minimum.

Impurities in Distilled Water

Making too much No. 2 ice is a matter that will worry any conscientious engineer, and the reasons for making either opaque ice or ice with a dirty core are many. The principal preventative, however, as to opaque ice is the exclusion of air in the distilled water. There should always be a moderate flow of steam from the vapor pipe at the top of the distilled water tank to exclude the air, but an excessive flow means waste of fuel. The connections to the can filler must be tight and removing the can filler from the filled can should be done with as little agitation as possible; also see that the overflow from the distilled water tank is trapped, thus preventing air from entering the tank through that opening. Also turn the cans bottom up after the ice is dumped, in order to drain properly. If the above instructions are strictly adhered to, there will be little danger of having opaque ice.

As to dirty core in the ice, cleanliness of the tank man is absolutely essential. The top and bottom of the lids should be kept as clean as circumstances will admit, also the timbers that the lids rest on because, in removing and replacing the lids, some of this dirt and filth will drop into the distilled water and finally freeze in the center of the block. When lifting the cans out of the bath, leave them suspended directly over the opening until the can filler has been changed and lids replaced, thus allowing them to drain, preventing sloppy bath lids, and making it more comfortable for the operator without encroaching upon his time.

Should this part, however, be found satisfactory and still a bad core is produced, then the water must be at fault, and to locate the trouble it will first be necessary to determine the character of the impurities contained in the feed and cooling waters. Procure the proper chemicals that will cause a precipitation of the matter held in solution and test them; as for instance, most natural waters contain chlorides or sulphates, and the addition of a drop of a solution of nitrate of silver or chloride of barium in a tumbler of water will cause a white precipitate in water which is not distilled or not properly distilled. It can readily be ascertained which chemical answers best by testing the undistilled feed and cooling water and use the chemical that produces the greatest precipitation.

Now test the water entering the cans, using the same quantity of water and chemical solution, and note the difference, if any, in precipitation. Next test between the distilled water tank and filter; should there be no precipitation, the fault is in the filter and the remedy is plain.

If the impurities continue, test between the distilled water tank and the steam boiler; if the water is clear, the trouble is in the distilled water tank, and unless the tank has recently been opened or emptied so as to cause rust, it is due to a leaky cooling coil or pipe, as the case may be. In order to determine which coil leaks, close one at a time; after pulling several draws, test again; if clear, the trouble has been located and the coil must be cut out; here again will be found the value of a few extra valves.

Should the impurities still exist, either the water in the steam boiler is carried too high at times, the surface blow not used often enough, or the heater and purifier is defective; if the latter is the cause, the remedy also is plain, and this can be determined by using both the surface and regular blowoff more frequently, and if after a test the water shows an improvement, it is clear that the heater and purifier is at fault and should be cleaned as soon as possible, because the extra blowing off means just that much additional fuel to heat the water blown to waste.

The water may accidentally get too high without the knowledge of the engineer in charge, in which case a high and low water alarm will be the remedy, because when he hears the high water alarm, and say 48 hr. afterward finds impurities in the ice, he will at once know the cause, and also know that it will be all right after a few draws; in fact, the fireman will exercise extra care not to have it occur, knowing that everybody about the plant will know it.

Another cause for impurities in ice is pulling and filling more per hour than the regular number, because it lowers the water in the distilled water tank below its normal height, and possibly nearly or quite on a level with the top of the filter, thus agitating any residue that may have collected there, and giving the water in the cans a cloudy appearance and also increases its temperature. The variation of a few degrees in any part of the plant rarely receives the consideration that its importance entitles it to, as for instance, an increase of 5 deg. in the temperature of the distilled water is equivalent to the reduction of 1 ton of ice on a 50-ton machine. To illustrate, the addition or abstraction of 1 B. t. u. per pound of water, increases or decreases the temperature about 1 deg., and increasing the temperature of the distilled water 5 deg. on a 50-ton machine of 2,000 lbs. per ton, the example would be $2,000 \times 5 = 10,000 \times 50 = 500,000$ additional heat units to be extracted by the gas in the expansion coils in order to produce the same capacity as heretofore. The standard for 1 ton of refrigeration is 284,000 B. t. u., but to produce 1 ton of ice there must be abstracted from the water enough heat units to equal about 1.5 tons of refrigeration; hence, allowing for losses by radiation in tanks, exposure, and meltage in removing ice from cans 500,000 B. t. u. would be equal to 1 ton of ice every 24 hr.

There is still another objection to pulling ahead, it decreases the height of brine surrounding the cans. One extra draw will lower the brine, approximately, 1 additional inch, and as the center in the top of the block is always more or less difficult to freeze solid, it is plain that, if the brine is lowered much, the difficulty increases.

REFRIGERATION, OIL SEPARATORS AND AMMONIA CONDENSERS

By Charles L. Hubbard

THE oil trap and separator commonly consists of an iron or steel cylinder of the general form shown in Fig. 1, gas entering at the top in a downward direction, which throws the oil to the bottom of the chamber, while the gas passes on to the condenser in an upward direction as indicated. This is known as a high-pressure trap and the oil is often led by means of a pipe to the stuffingbox, thus acting as an automatic lubricator. Other forms are sometimes used, containing baffle plates similar to steam separators.

Ammonia Condenser

When the ammonia leaves the expansion coils or evaporators it is in the form of a gas at a low pressure and temperature, usually 5 to 10 deg. below that of the surrounding medium, although it has just absorbed a certain amount of heat in the process of vaporization. It is then drawn into the compressor and compressed to such a point that it will liquefy at ordinary temperatures. Although it now occupies a much smaller space than before, it still contains practically the same amount of heat, hence its temperature is much higher. As the gas enters the condenser in this condition, it is hotter than the water surrounding the coils and so gives up a portion of its heat and is condensed to liquid form.

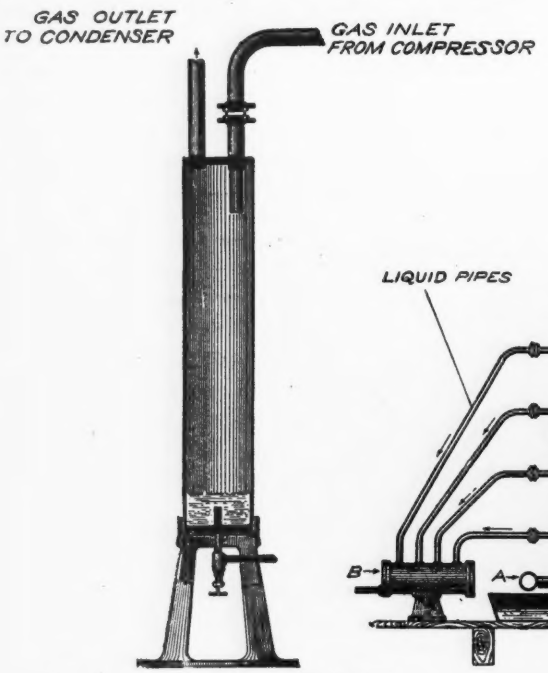


FIG. 1. OIL TRAP AND SEPARATOR

Condensers are divided into 3 general classes, known as the atmospheric, submerged and double-pipe. Fig. 2 shows a common form of return-bend

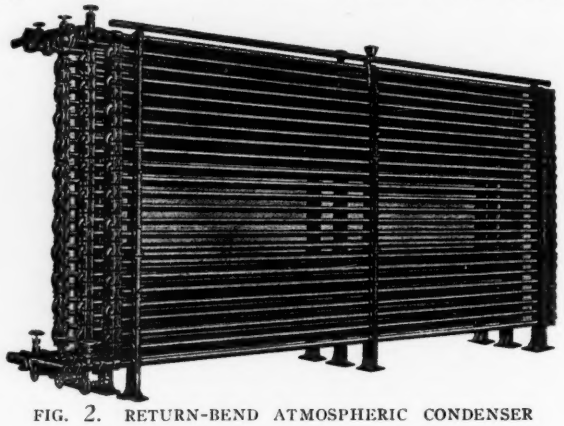


FIG. 2. RETURN-BEND ATMOSPHERIC CONDENSER

atmospheric condenser, which consists of vertical coils of pipe arranged side by side, over which the water flows from a trough or perforated pipe, thus cooling the compressed ammonia flowing through the coils. This type of condenser is usually made up of extra-heavy 2-in. pipe supported upon cast or wrought-iron stands.

The method of making the pipe connections for the ammonia and cooling water vary a good deal in different cases. In Fig. 2 the gas enters at the top and the liquid ammonia flows from the bottom to the receiver. It will be noticed that the flow of water and gas is in the same direction, the coldest water coming in contact with the warmest ammonia, which is just the reverse of conditions for ideal results, and is an arrangement not favorable to a low condensing pressure or economy in the use of water.

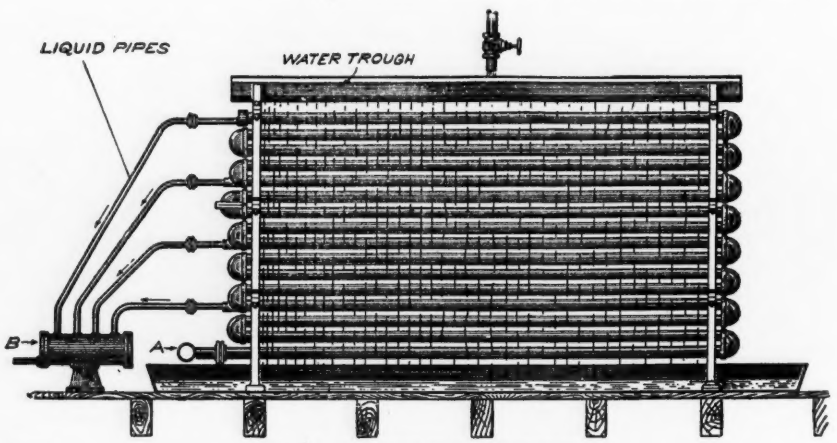


FIG. 3. REVERSE-FLOW CONDENSER

In the form shown in Fig. 3 this objection is overcome by supplying the ammouia at the bottom of the coils at A and drawing off the liquid at intervals into

a receiver B as shown. In this way the flow of water and ammonia are in opposite directions and the desired condition is obtained.

The usual form of submerged condenser is similar to the one shown in Fig. 2 except that it is submerged in a tank of water. The tank is commonly made of wrought-iron or steel properly braced to prevent bulging. The cooling water is supplied at the bottom and overflows at a point near the top. The ammonia enters the coil at the top and passes downward, thus securing the condition of a reverse movement of the water and ammonia so much desired.

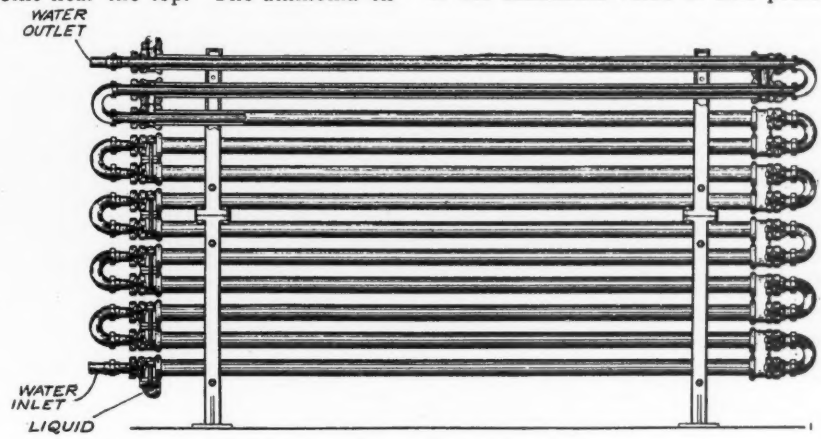


FIG. 4. DOUBLE-PIPE CONDENSER

Another form of submerged condenser consists of a cast-iron or steel cylinder containing several sets of pipe coils through which the cold water flows; the ammonia in the cylinder being cooled by contact with these pipes. This type is similar in appearance to a feed-water heater and is frequently used as a liquid ammonia receiver as well as condenser, and is provided with gage glass and cutoff cocks.

The double-pipe condenser is shown in Fig. 4 and consists of a series of coils, one pipe within another, so arranged that the ammonia is circulated downward through the outer and larger pipes, while the cooling water is circulated in the opposite direction through the inner and smaller pipes. This type may be located anywhere except where the temperature is abnormally high or so low as to be subjected to freezing.

OFFSETTING CYLINDERS IN SINGLE-ACTING ENGINES

Concluding a paper presented before the American Society of Mechanical Engineers on the effect of offsetting the cylinder to one side of the center line of the crank shaft of single-acting engines, Professor T. M. Phetteplace states that for this construction the length of stroke for a given radius of crank increases as the offset increases and decreases as the ratio of the length of connecting rod to length of crank increases; that increasing the length of the stroke causes an increase in average piston speed because offsetting the cylinder makes the crank and connecting rod a quick return mechanism, so that the crank during the out stroke of the piston passes over more than 180 deg. and during the in stroke over less than 180 deg.

The advantages of this offset he states to be that the friction of the piston on the walls of the cylinder is reduced, causing slight increase in mechanical efficiency and less wear of piston, piston rings and cylinder, with consequent longer life. There is also a reduction of the maximum value of side pressure of the piston on the walls of the cylinder, permitting the use of shorter connecting rods, shorter pistons and shorter cylinders in the trunk type of engine, thus giving a shorter and lighter engine with lower inertia forces. The reduction of side pressure grows less as the speed increases, so that above 1,400 r. p. m. there is no advantage in this respect. This method of setting the cylinder has been used on a number of gas engines that have been put into operation mostly for automobile work. The amount of offset varies from 100 per cent of the crank length down to 15 per cent, most of the engines having an offset of from 30 to 50 per cent. The ratio of connecting rod to crank varies from 3.5 to 4.75 and the diameter of the piston from 4 in. to 9 in. The ratio of piston length to diameter varies from 1 up to 1.47.

As stated by A. W. Gibbs, superintendent of motive power for the Pennsylvania R. R., the requirements for smokeless combustion are:

First, to distill the volatile gases at as uniform a rate as possible.

Second, to present to the burning gases an adequate supply of air to effect complete combustion.

Third, to thoroughly mix this air with the gases.

Fourth, to effect this mixture while the gases are still at a very high temperature.

Fifth, to allow sufficient time for this mixture and combustion of the air and gases to take place before the heat is absorbed and the temperature reduced below the combustion point.

With these 5 conditions complied with, the whole difficulty is overcome.

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COST OF POWER

As an example of what may be done in the way of reducing cost in a power station by careful study of operating conditions and by adoption of the most economical methods of generation and transmission, the reports of the operation of the Boston Edison Co. are worth while studying. This company has taken the lighting plants of the different cities which make up Boston and its suburbs, has consolidated these into one system, utilizing every possible means of increasing the efficiency of the stations and as a result has shown a steadily decreasing cost of current delivered to the customer.

The items which go to make up this total cost are the cost of manufacture or cost at the station switchboard and the distribution cost, and in these 2 items have been included overhead expense, rent, taxes, etc. The low values which the Edison Co. has achieved are not possible in a small plant but show the limit towards which the small plant may strive in trying to compete with the big central station.

The total cost of manufacture per kilowatt-hour for 1904 was 1 cent; for 1905, 0.87 cent; for 1906, 0.8 cent; for 1907, 0.785 cent; and for 1908, 0.825 cent. This shows an apparent slowing down in efficiency from 1907 to 1908 but in analyzing the manufacturing cost the coal cost per kilowatt-hour runs as follows: 1904, 0.53 cent; 1905, 0.436 cent; 1906, 0.41 cent; 1907, 0.428 cent; 1908, 0.463 cent. The cost was, therefore, considerably higher in 1908, and this was due to the rise in the price of coal, for the price paid per ton during these years was, for 1904, $4.19; 1905, $3.52; 1906, $3.48; 1907, $3.60; 1908, $3.99, and the coal consumptions per kilowatt-hour were, for 1905, 2.79 lb.; 1906, 2.64 lb.; 1907, 2.67 lb.; 1908, 2.6 lb., so that although less coal was burned per kilowatt-hour the rise in price increased the total manufacturing cost.

The labor costs per kilowatt-hour during this period were, for 1904, 0.236; 1905, 0.23; 1906, 0.21; 1907, 0.21; 1908, 0.192, showing a continually increasing efficiency in the handling of the plants, due largely to the increase in steam pressure and increase in size of the units used.

The distribution cost was, of course, affected by the amount of territory covered and the length of distribution lines. The policy of the company has been to consolidate stations, using the smaller stations only for emergencies and as substations, thus making a continual increase in transmission distance. Spite of this, the substitution of alternating current distribution for direct current, with corresponding increase in voltage, has worked an economy in the distribution cost. The efficiency of distribution was, for 1905, 65 per cent; 1906, 68.5 per cent; 1907, 71.5 per cent; 1908, 68.5 per cent. Apparently the changes during the years 1907-8 in the line of consolidation had reached the point where the length of distribution lines was too great for economical transmission at the comparatively low voltage, 6,600 volts, used on the Boston Edison system.

The distribution cost went down about as the efficiency went up, being for 1905, 0.73 cent; 1906, 0.65 cent; 1907, 0.62 cent; 1908, 0.68 cent.

Looking at the figures for 1904, they would have been considered and would be considered even today, a very good showing for a central station and it would be not unnatural for the engineers of the company to rest on their laurels at this point, but continued study of methods of using fuel, possible improvements and changes, has resulted, as seen, in a considerable decrease. To be sure, the difference between 1 cent and 0.8 of a cent does not look very large, but when it is multiplied by 60,798,000 it becomes $121,596, which is a pretty respectable saving and worth while doing considerable hard thinking to secure. Such results mean continual watchfulness and alertness, not only to secure the best carrying out of present methods of operation, but to devise new economies in using station supplies, new arrangements to get the most possible heat units from the coal and save them after they are gotten, and new ideas as to the generation, transformation and transmission of the energy throughout the system.

KNOWLEDGE ABOUT THE GAS ENGINE

Frequently it comes to the attention of one going about among engineers and manufacturers of engineering apparatus that the great reason why the gas engine, with its brilliant possibilities, has made such slow progress in practice is because of the lack of knowledge of what it can do and how to take care of it, and with all due respect to the activity of the gas engine builders, this condition of affairs must be laid largely to their door. Steam engineers have been willing to learn facts about the gas engine and how to run it. Manufacturers have too often been content with giving out glittering generalities as to the possibilities of the gas engine and statements about the theoretical advantage of using it.

A suggestion recently made that the trade papers should publish information in regard to actual operation and running of gas engines is a good one. Here again, the papers have been waiting, even begging, for such information and have not been able to get it in any sufficient quantity. We welcome, and we are sure that our readers will join us in this feeling, the determination of gas engine builders to furnish details in regard to their engines, good information as to what may be expected in the daily running of gas engine plants, and educational matter to help engineers understand what the engine will do and what to do for it. Practical Engineer certainly stands ready to co-operate with builders, owners and operators in giving such information the greatest possible publicity.

EDITORIAL CHAT

For Your Convenience

How often in reading an ad. we think, "Well, I'd like to know more about that"; but paper is lacking and it isn't convenient to get any just then, so our opportunity passes by and we forget. Getting information and getting posted means getting ahead, so it doesn't pay to let opportunity slip. Here's where we (editorial "we") give you a lift.

You will find in each issue convenient blank forms on which to write for catalogs or information, so that all you need is a pencil and a stamped envelope. You can fill out the blank as the inspiration comes, and mail it when convenient. This is in line with our steady policy to help you all we can. Has anybody any suggestions for some other good thing?

Diluted Steam for Engines

It is an interesting field for speculation that is opened up by Mr. MacFarland's article on p. 123 of the February issue. The idea of injecting steam into the charge of a combustion engine to cool it, at the same time superheating the steam and making it do work during the expansion stroke is familiar. The steam takes heat from the hotter gas and, in expanding turns it into work; that gets 2 cherries at 1 bite; keeps the cylinder cooler and gets more work out of the gas. This helps the gas engine to lick the steam engine by using steam and that's a mean advantage.

Now the steam engine is to borrow help from air; not "hot air" to boom it, but compressed air to take heat from the steam and then expand to a low temperature, giving up work as it goes. It's a game something like the low-pressure turbine used as an auxiliary to the main engine that Mr. Bibbins discusses in this issue—a something for nothing operation.

But, the trouble with using a single cylinder engine condensing is that the temperature difference between live and exhaust steam is too great. It makes a lot of condensation of live steam, and so the engine gets compounded to make it mend its ways. Now, this air-steam proposition means a big temperature difference—acts like an inside condenser plant—every engine its own condenser—and what will that do to the live steam condensation? The more air, the more cooling down of the steam while expanding. How much air is it best to use?

It's all guess work now, for we know mighty little about how mixtures of air and steam act. But it looks like a good possibility for a new wrinkle in conservation of heat units; and incidentally there's a big field for investigation by our engineering college students who are hunting for thesis subjects.

What do you think of the scheme? Don't all speak at once.

"AT THE PRESENT RATE, in less than 30 years, all our remaining virgin timber will be cut. Meantime, the forests which have been cut over are generally in a bad way for want of care; they will produce only inferior second growth. We are clearly over the verge of a timber famine."

ELECTRICAL MACHINERY AND APPARATUS

TRUING UP COMMUTATORS

KEEPING commutators true is an important point in successful running of direct-current dynamos and motors. If well built and well cared for and not loaded so as to over heat, a commutator may run for a long time before other truing than an occasional polishing is required. But when more elaborate treatment is needed, it should be given without waiting until the surface is gashed and pitted.

In the Electrical World, W. Burns gives some valuable hints on the methods to be pursued.

For small ridges, a fine file with polishing afterward with sand paper is usually sufficient, as the usual end play of ⅛ to ¼ in. keeps it from grooving. Brushes should be set so that all parts of the commutator are covered.

Motors which are hard to get at are, however, often neglected as long as the shaft will turn, and then only a thorough truing will answer.

In the smaller sizes, where the armature can be easily removed from the machine, the turning up is best done in the lathe. Centers for this purpose are usually made in the armature shaft, when the machine is being built. After the key has been drawn from the pulley or gear which is on the end of the shaft, the bolts which hold the end bearing in place are unscrewed and the bearing drawn off.

Packing should first be placed between the 2 bottom pole faces and the armature core, to prevent injury to the windings, thin pieces of wood or cardboard being suitable. The armature may then be withdrawn by hand, if light enough, or by rigging up a chain block if it is too heavy to handle, great care being taken to avoid knocking it in any way. It is then placed on the lathe centers.

If the shaft has been in use for some time and the journals show signs of wear, it will be necessary to apply an indicator to the journals to make sure that they run true. Should they be slightly out of true, the center must be scraped with a center scraper till both journals run properly. If no attention is paid to this point and the commutator is turned up without shifting the center, when the armature is replaced in the machine the commutator will probably run hot and spark at the brushes, necessitating turning again in a very short time.

A narrow, pointed tool, somewhat like a thread cutting tool, is the most suitable for turning the commutator, the turning speed being as fast as the tool will stand, and the feed very fine. A broad-nosed tool ought not to be used, as it is liable to burr over the segments. The sharp-pointed tool does not produce a finished surface, but this is easily attained by filing lightly with a very fine file, then polishing with coarse and fine carborundum or sandpaper. If a little oil is used, when finishing with the fine carborundum cloth, it will produce a nice, smooth polish; or, should the electrician think that this will harm the insulation, a little paraffin or a piece of a paraffin candle may be used.

A covering of some sort should be placed over the windings and tied in position to keep any particles of metal from getting in during the turning operation. At the points where the windings are soldered to the commutator lugs, a brush should be used to remove any dust or particles of copper. The insulation between the segments should be examined after turning to see that the commutator is not short-circuited by a chip or burr of copper.

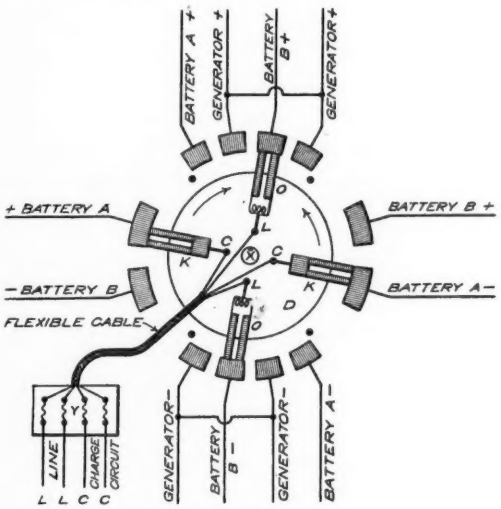
Before removing the armature from the lathe, any rough spots on the bearings should be filed and polished with emery cloth. The armature is sometimes given a coat or 2 of shellac varnish before replacing, but during this operation great care should be exercised, as a knock against the commutator or armature windings may undo all the work.

When the armature is too large to be conveniently taken out, a portable turning rig may be used to true the commutator in place, this rig being fixed to the end bearing or the frame of the machine. The same tools are used as when the turning is done in the lathe, all parts where chips may lodge and harm the insulation being carefully covered. The engine usually requires to be run slowly or disconnected during the turning operation, the armature sometimes being rotated by hand or by means of some portable motor, depending entirely on the material that is accessible. This turning rig is usually a slide rest of some description fitted with a traversing screw and means for feeding in the tool. Sometimes an ordinary lathe slide rest is used, being suitably mounted and clamped in place. A portable grinding machine is often used for truing up some of the larger-sized commutators.

In this connection the truing up of the commutator on the dynamo which supplied the electrical energy for a large works may be of interest. The commutator was giving trouble by undue heating, and, as a flat had formed, it was decided to true it up and see if that would improve matters. To avoid stoppage of the work, it was arranged to be trued up at night after work had stopped. To attach the grinder to the machine, the 4 cap bolts on the bearing were removed and 4 longer bolts were inserted to allow for the thickness of the bars which formed the base of the grinding fixture. The grinding wheel was driven from the commutator by means of a rubber-tired wheel held in con-

tact by a spring which could be adjusted to any desired tension. A coarse and a fine wheel were used in turn. The machine automatically traversed back and forward, the feeding in of the wheel being done by hand. A coarse-grained wheel was used to remove most of the material, the engine being run at nearly full speed, as this was when the wheel seemed to cut most freely.

After the flat had been ground out, the fine-grade wheel was put on, and soon brought the surface to a fine finish. A final smooth-up with fine carborundum cloth finished the job. The top part of the brush carrier ring had to be removed to make clearance for the grinding rig; the bottom half was left in place and pressure taken off the brushes. This allowed them to slide back in their holders, after which a cloth was passed underneath to catch the copper dust, of which there was a large amount. The armature was also completely covered. When the brushes had been replaced and the machine run for some time, there was no further trouble from heating.



ROTARY SWITCHING DEVICE

ROTARY SWITCH FOR POSITIVE POTENTIAL

BY MALCOLM C. SAEGER

A great deal of closed circuit work is dispensed with in modern wiring of low voltage systems for the lack of a continuous flow of current at all times and under all conditions. The switch illustrated in the diagram will overcome this source of trouble, there are in the first place 3 sources of current for the load, 2 sets of storage batteries and 1 generator, all of the same potential. There is no possible chance to open the line as the rotating switch blades enter 1 source of current before it leaves another.

It will be seen by close observation that when blades O pass from the generator stud they enter the studs of the battery A. The blades K also follow the movement of the disk and enter the charging circuit on the battery B. The position of the blades in the diagram shows the battery B on the line and A on the charging circuit. Either battery or the generator can be operated individually over the line. In the illustration X represents a brass sleeve for a shaft keyed to the operating wheel placed in front of the board. Disk D to which the blades are bolted is made of fiber. A stationary outlet box V contains the fuses for the charging and main line circuits.

IN THE EARLY DAYS OF DYNAMOS

In the laboratory of Thomas A. Edison were trained many of those who have since taken prominent parts in the development of electrical industries and the doings of those first attempts at electric lighting which after all were made but a short time ago, sound strange and like tales from a foreign land. Before the Schenectady, N. Y., section of the American Institute of Electrical Engineers, W. S. Andrews recently gave some recollections of his pioneer work which are worth reprinting:

In the days when we first started in with electrical wiring we had no wire of any kind, with the exception of a limited quantity of some that was single cotton covered. After a great deal of work, however, we persuaded some the the wire manufacturers to make for us what was called cotton-braided wire, which was covered with a coat of white lead, and known as Underwriters' wire. But this was far from perfect, as moisture took to it very quickly. After 2 or 3 fires happened, it was re-christened "undertakers' wire."

In 1883, on the fourth of July, Edison started his 3-wire station in Sunbury, Pa.—a quarter of a century ago; a short time to look back to, but a long time to look ahead to.

All dynamos of the Edison system were of the low-tension type, 115 volts being about the highest pressure used. These were all made at the Edison Machine Works, New York City. Three types of belt-driven machines were standard at that time. This was in 1882. These machines were standardized according to the number of 16-c. p. lights that they would carry without undue heating. There was the Z machine which would carry 60, the L which would carry 120, and the K, 240—each size thus carrying double the number of lights of the one before it.

In testing these machines electrically, they were connected to a large bank of lamps on the ceiling of the testing room, which was very high. The bank consisted of about 1,000 16-c. p. lamps. There were no voltmeters at all, and the only means we had for measuring was by means of a standard battery made up of very small Daniel cells. The solution was carefully made of chemically pure acid and distilled water. It was supposed that the electromotive force of these cells was 1.079. We connected them in series with a Thomson galvanometer and high resistance of 20,000 or 30,000 ohms; a very crude way, but the best we had. It was my especial duty, once each week, carefully to

clean the battery and renew the solution so as to insure the voltage remaining constant.

It was also common practice to check the candle power of incandescent lights by comparing them with a standard candle which was supposed to burn 120 grains of tallow in an hour. Of course, we had to weigh this before and after burning.

The only means of maintaining normal voltage in lighting plants was by observing a pilot lamp located on the headboard of the dynamo. When a man was sent out to set up a dynamo he would show the engineer how bright this pilot lamp ought to burn at the proper voltage.

The story of the Cumberland station is worth recalling here. Word came to Edison in New York that the Cumberland people were burning out armatures rapidly. I made my appearance at the station in the evening and was met by a colored man, the engineer. I asked him if he were the only attendant, and if he attended the boilers, engines, machines, etc. He said, "Yes, sah; I'm a hustler!" I asked him if he had been burning out armatures lately, and told him that I had come from New York to give him advice. I then asked him how he knew when the dynamos were carrying too much current. He said that some one had told him that when the wires were carrying too much electricity they would get hot. He therefore felt of the wires occasionally, and if he found one getting hotter than the others, he would put in a little more resistance and cool it down. So far as I know, this is the first record we have of a "hot wire" ammeter.

I went back and reported to Edison. Edison said, "We have got to get up an ammeter." We set to work and made some in about a week or so. We got up the old Edison pendulum ammeter, and the first sample of this device was shown to Edison at the machine works. He said it was pretty good, but that we needed something rough. "Have 6 made up. When you examine and test them in the testing room, have them packed and then call me. I do not care to see them until packed and ready for shipment." When this was done, he was notified and came in. Edison said, "Put them on the table. Now, then, get up on the table and kick'em off; for if they won't stand this, they will never reach Cumberland in operating condition." They were kicked off the table as hard as the fellow could kick them, and sent spinning over the floor. Edison then said: "Now I will look at them." Then after a careful examination, they were approved for shipment. It is needless to say there were no jewel bearings in the instruments at that time.

TELEPHONE BELL RELAY

BY E. T. REED.

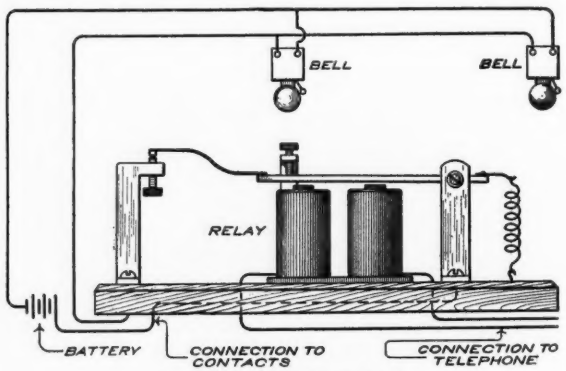
In the accompanying sketch I have shown a telephone relay which I used in a plant in which I was employed.

It was necessary that the engineer on watch should hear the bell whenever it rang, but it was not necessary for him to answer unless his number was called, so the drop system would be a nuisance as the engineer would be compelled to throw it in again every time the telephone rang.

The bell coil in the telephone can be used for the relay or another of the same resistance. The relay coil is connected in parallel with the telephone bell and its armature will vibrate the same as the armature that rings the bell.

It will be seen from the sketch that when the armature is drawn down it brings the contacts together, which close the secondary circuit, causing the bells to ring.

Due to the thin stop on the end of the armature the vibrations do not open the circuit, as they are



TELEPHONE BELL RELAY

taken up by the spring, and the bell rings until the armature goes back to its stop.

In a system where each telephone has its own number it is necessary that the relay cause the bells to repeat properly the numbers, which this system does very well.

The success of the relay depends on the metal strap on the armature, which must keep contact while the bells are ringing and must break it when the armature returns to its stop.

The bells are ordinary vibrating bells and are so placed that the engineer can hear them in any part of the plant. Any number of bells can be used and they can be as large as desired. The only expense incurred for this outfit was for bells, wire and battery.

CIRCUIT BREAKER ALARM

BY J. C. HAWKINS.

I have found out by experience that there is once in a while a company that considers the power plant to be of secondary importance when it comes to having things modern and convenient and usually in such plants the engineer's duties are so widely scattered or he has so much to do that it keeps him on the jump to keep all the wheels turning. Such I found to be the case some time ago; the boilers, engines and generator were up-to-date but the method of connecting them up was very bad, especially the electrical distribution system.

The generator, a 200-kw., direct-current, 250-volt machine, was connected to a single panel switchboard with a main switch and circuit breaker, volt and ammeter, with 3 separate circuits connected to the 1 switch and leading to different parts of the mill, which at times employed about 400 men and used about 50 motors ranging from 5 to 50 hp. and it can easily be seen that the working of the whole mill depended on the 1 circuit breaker, and as the engineer has 6 boilers, 3 pumps and 2 engines to look after, and no oiler, he does not have time to watch that circuit breaker very

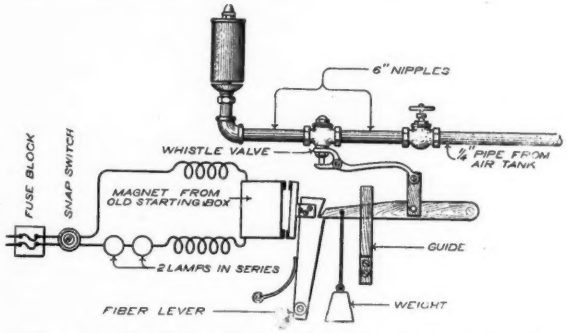


FIG. 1. ARRANGEMENT OF WHISTLE CONNECTIONS

closely although he is expected to get it back in operation as soon as possible after it opens to keep the mill going.

The power house and mill are only 50 ft. apart and the 3 circuits on entering the mill are divided into about a dozen, so that the proper remedy would be to install about 2 more panels and put a switch and circuit breaker on each line; then when a short occurred on 1 circuit the whole mill would not have to stop, as it would only affect the 1 circuit.

Sometimes it is 5 to 10 minutes before the engineer discovers that the breaker is out, if he is in the boiler room; this causes the company lots of trouble as well as expense, so I asked for an electric gong to connect to the circuit breaker to ring when the breaker was out, but was refused on the ground of unnecessary expense. But I decided to have some kind of an alarm and I happened to think of an old whistle, which I hunted up, and by getting a new valve and some more scrap I managed to get a respectable kind of an alarm. The manner in which it is connected up is given for the benefit of anyone else in the same fix that I was.

I ran a ¼-in. pipe from the air tank to a convenient position, put on a globe valve, then a 6-in. nipple and the whistle valve with the lever in a horizontal position below the valve, then a 6-in. nipple, an ell, another nipple, this bringing the whistle in a vertical position beside the board on which it is mounted.

The weighted lever below the whistle is about 8 in. long and works in a guide. It drops when the magnet pulls the fiber trip away from the lever, thus opening the whistle.

The magnet was taken from an old 10-hp. starting box and as it would not stand the full voltage it was necessary to put 2 110-volt lamps in series with it. The connection to the circuit breaker is a phosphor bronze strip about 0.25 in. wide, held by a fiber block in such a position that when the breaker is closed it just clears the latch hook, but when the breaker is open the hook drops low enough to make a contact with the strip of bronze to which 1 wire is connected, which closes the circuit as the other wire is tapped to the other side of the line, causing the current to flow through the fuse, switch, lamps and magnet, causing the latter to attract the steel plate riveted to the fiber trip lever,

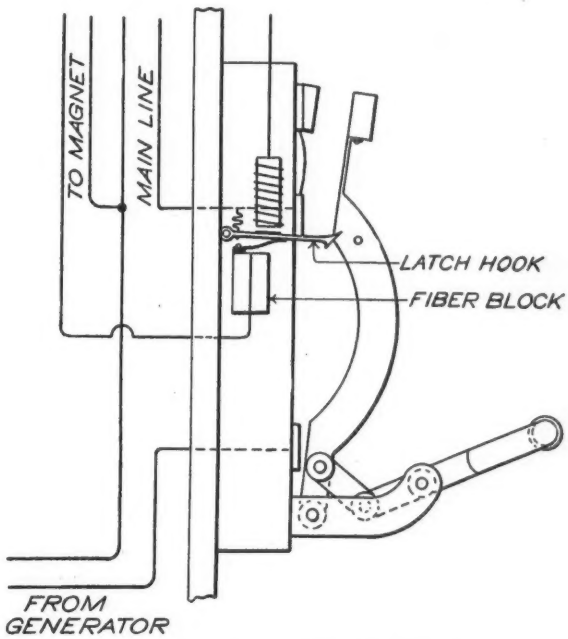


FIG. 2. CIRCUIT BREAKER CONNECTIONS

thus letting the weighted lever fall and blow the whistle until stopped either by shutting off the air or resetting the trip. When it is desired to leave the breaker out for any cause, the snap switch is turned, thus cutting off the current from the magnet, or the air valve may be shut.

It took some little time to get it working right and no doubt cost as much as a gong, but as it was made out of material on hand the cost was not noticed and it saves the company quite a sum of money in a year, as the engineer is notified at once when the breaker is out. It works so well that the superintendent says that I am to connect the telephone and a high and low water alarm for the water tank to it and, if that is done, it looks to me as if someone would have to listen to that whistle about half the time.

FOREIGN ADVERTISING

At a recent meeting of the Technical Publicity Association, Chas. S. Redfield, advertising manager of the Yale & Towne Mfg. Co., gave an interesting talk on the above topic, and speaking of the trade papers in Europe, said that they could be most justly

dealt with by giving them a good "knocking," but that the unwritten law says that "you should not kick anybody who is down," and European trade papers may certainly be considered down and more or less out.

He attributed the poor quality of the supply to the fact that there is little demand for good trade papers in the various industries and stated that in his mind a properly conducted trade paper should produce its own demand and then fill it, the thing which gives to the trade papers in America their definite and needed place in the business world. In France, where Mr. Redfield spent nearly a month, he found no strong papers in the hardware and machinery fields except a couple of scientific rather than commercial papers dealing with machinery. In England the condition is rather more like America, as there are several strong trade and technical papers. As to the Germans, the Yankees of Europe, he expressed admiration of their energy and wide-awakeness. They are imitating competitors' goods and methods keenly everywhere with a particularly slavish imitation of everything which promises a dollar for the imitator. In this respect Mr. Redfield said Germany has the rest of the world "skinned to death." He was particularly impressed with the respect of all the older countries for American ideas.

He believes that the technical and trade paper performs absolutely necessary work here and that in time such papers will become in Europe influences for good in their several lines, but it will be a number of years before this result is reached. Mr. Redfield stated that in his judgment for any American manufacturer to attempt to use the trade papers of Europe extensively to push the sale of his goods at the present time is a poor investment, unless that manufacturer has in the various countries careful agents who are capable of taking and using a certain amount of trade paper space, watching it carefully, furnishing good reading notices to the papers and supervising them at close range.

He spoke of the export publications printed in America by export houses and others, dividing them into good, bad and indifferent, of which he had found some of them bad, one or fwo indifferent, and stated he was still on the hunt for a few good ones. Theoretically, the proper paper for an American to advertise in is one printed and distributed in the country which he wishes to reach, but practically he thought that good trade papers printed in America and intelligently distributed abroad may prove better mediums than the feeble papers, which are the rule rather than the exception in European countries.

Among other speakers of the evening who knew of the conditions of foreign papers there was general agreement with the ideas expressed by Mr. Redfield. A novel idea advanced by C. N. Manfred, of the H. W. Johns-Manville Co., was that foreign catalogs which are translated from English to a foreign language would well be retranslated into English to see how near the foreign corresponds to the original English copy.

VALUE OF FLUE GAS ANALYSIS

In a recent boiler plant test made by the coal department of The Arthur D. Little Laboratory, Boston, the loss due to unburned gases from a thick, uneven fire was illustrated by an interesting occurence in connection with the flue gas analysis. The test showed the following relative conditions:

	1	2
Sample of Gas taken	5:00 p.m.	5:30 p.m.
Carbon dioxide CO_2 per cent	11.3	14.3
Oxigen O_2, per cent	6.5	5.5
Carbon monoxide CO, per cent	2.4	0.0
Nitrogen N_2, per cent	79.8	80.2
Air excess, per cent	45	36
Temperature flue gas, deg. F	545	700
Heat lost due to CO, per cent	9.7	
Heat lost due to increased temperature of flue gas, per cent		4.3

The first analysis shows a considerable amount of carbon monoxide to be present. Before taking the next sample this monoxide started to burn through the passes of a 600 hp. Aultman & Taylor boiler and the monoxide was being entirely consumed. The flue temperature rose 155 deg. on account of this burning through the passes of the boiler instead of in the furnace. There was no combustion chamber and the fire was so thick that it came close to the bottom row of tubes.

A number of conclusions can be drawn from this instance:

1. Had the boiler been set with an ample combustion chamber all gases would have been burned before coming in contact with the heating surface, resulting in a gas analysis like No. 2 but with a temperature corresponding to No. 1.

2. The fire should not be carried so thick that carbon monoxide will be formed, as it is very difficult to burn it all in a boiler furnace when once formed, and the loss due to small percentages of monoxide is very great.

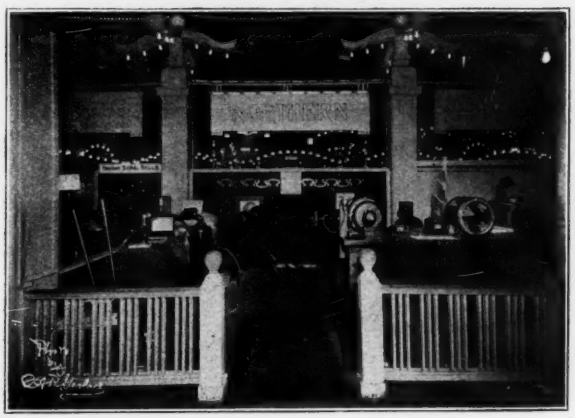
3. The determination of carbon dioxide alone is not sufficient to determine whether the boiler is being properly fired. In the case of No. 1 sample a CO_2 indicator should have shown 11.3 per cent CO_2, which would ordinarily have been considered very good, but there would have been no indication that monoxide was present, while the loss due to it was as great as if the CO_2 had been only 7.5 per cent with no CO.

BOOTHS AT THE CHICAGO ELECTRICAL SHOW

The accompanying illustrations represent the booths of some of the exhibitors at the Chicago Electrical Show, the photographs of which were received too late for publication in the February issue of Practical Engineer.

In Fig. 1 are shown valves, fittings and construction of apparatus manufactured by Crane Co. Rock drills and various parts of motors made by the Northern Electric Mfg. Co. are illustrated in Fig. 2.

EXHIBIT OF CRANE CO.

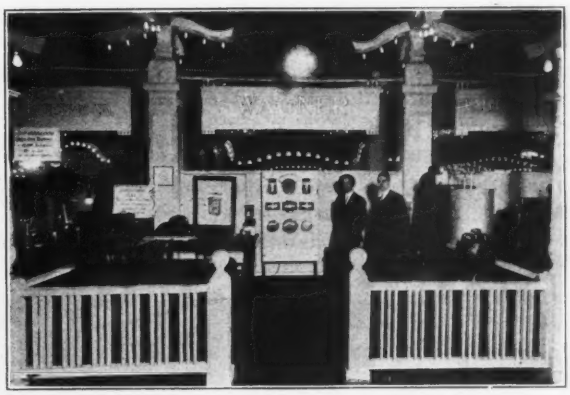


BOOTH OF NORTHERN ELECTRIC MFG. CO.

GENERAL ELECTRIC CO. BOOTH

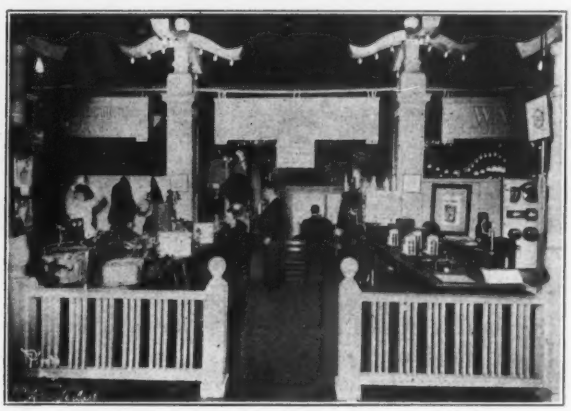
The General Electric Co.'s exhibit of cooking utensils and lamps is shown in Fig. 3. In Fig. 4 the arrangement of Wagner Electric Mfg. Co.'s booth is illustrated, showing alternating current motors and switch-board instruments.

The attractive features of the booth occupied by the International Correspondence Schools are shown in Fig. 5.



WAGNER ELECTRIC MFG. CO. EXHIBIT

BOOTH OF INTERNATIONAL CORRESPONDENCE SCHOOLS



WESTERN ELECTRIC CO. BOOTH

The Western Electric Co. had on exhibit a full line of telephone apparatus, its booth being illustrated in Fig. 6.

THE NEW POWER PLANT OF THE SOMERSET COAL CO.

BY W. B. SNOW

CONDITIONS have gradually forced the coal mining companies to a more careful consideration of economy in the generation and transmission of power. Such conditions did not appear necessary when coal was mined by hand, the distances were short over which coal was transported, the power house, if required at all, was close to the source of consumption, and there was no market for slack coal. The cost of generation and transmission of power in early developments represented but a small part of the total cost of mining and handling of coal.

As properties have been developed and the value of fuel has increased through improved methods of use for steam purposes, and as the distances over which coal had to be handled have also increased, the demand has been created for more careful consideration of the cost of power and its transmission at the mine itself.

But a most important influence upon the power problem has been exerted through the introduction of coal mining machinery. The power problem is therefore concerned not only with the surface plant where the power is produced but also with the widely distributed provisions for utilizing it beneath the surface. So long as compressed air was used exclusively within the mine, the surface plant necessarily included a compressor installation. But transmission of power through the medium of compressed air in pipes may be exceedingly inefficient because of losses through friction and leakage, and excessive maintenance charges, to say nothing of those incidental to utilization at local points within the mine and to extensions. The problem has been greatly simplified by the general application of electricity, although the difficulties in the way of its use for driving coal cutting machinery have not been easily overcome. Today, however, the

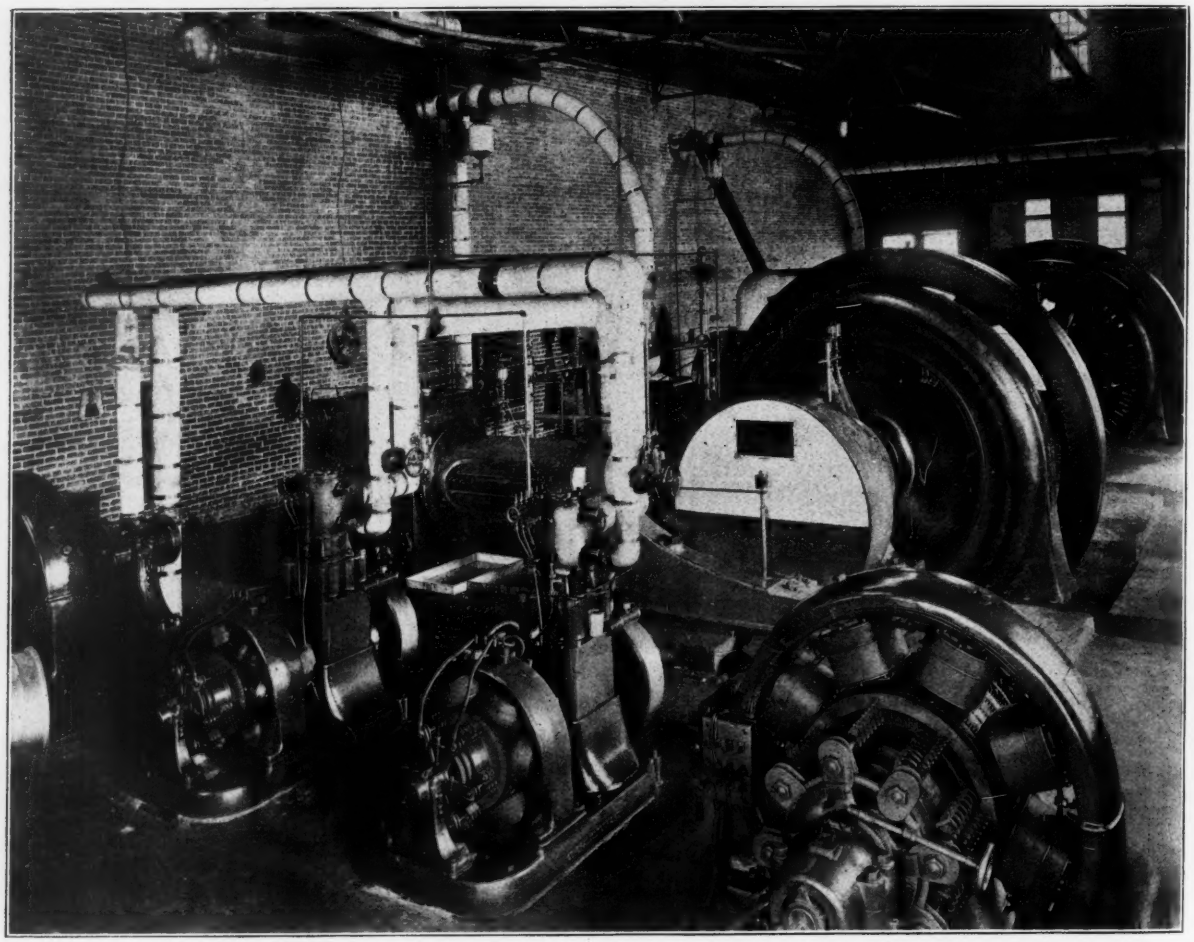


FIG. 1. ENGINE AND GENERATOR ROOM OF THE SOMERSET COAL CO.'S POWER PLANT

leading mines are using electricity driven compressed air coal punchers which successfully meet the requirements, and which make possible the elimination of air compressors from the surface installation. Such a plant has recently been installed by the Somerset Coal Co., at the Jenner mines, Jenner, Pa.

The power house is of brick with slate-covered steel trussed roof, cement floors, ample window space for light, etc. There are already installed 4 Babcock & Wilcox water tube boilers, each of 400 hp. capacity, and enough space remains for the accommodation of 2 more boilers of the same size. The present operations require the use of but 2 boilers, these furnishing steam for the engines, which operate the dynamos, and large haulage engine and the fan.

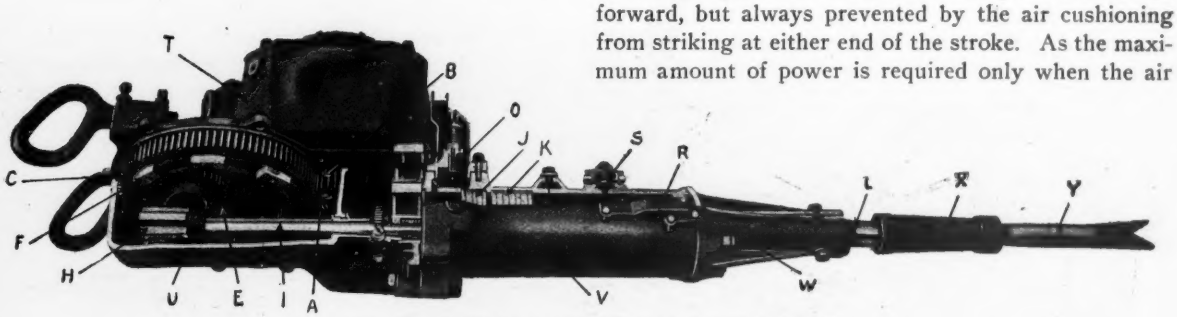


FIG. 2. SECTIONAL VIEW OF COAL PUNCHER

There are 2 30 by 14 by 30 in. modern Corliss engines of the Allis-Chalmers make in use, operating at a speed of 150 r. p. m., each driving one direct-connected 300-kw. 3-phase 60-cycle General Electric alternating-current generator, together with its auxiliaries. These generators furnish current at 2,300 volts delivered at the switchboard, from which point it is transmitted at this voltage to substations at No. 2 and No. 3 mines, where it is stepped down to 185 volts and converted by means of rotary converters to 275 volts direct current, for use on coal cutting machines, pumps and locomotives.

Current generated at 2,300 volts is also stepped up at the switchboard to 6,600 volts; transmitted over high-tension lines to No. 4 and No. 5 mines, 3.5 miles distant, where it is delivered to substations, again stepped down to 185 volts and converted into direct current at 275 volts.

By means of high voltage, the power is transmitted over very small wires and the investment in transmission lines consequently reduced to a minimum, thus making possible the use of a central generating plant and the transmission of power from this to almost any distant points at much less cost for each ton of coal produced than could possibly be the case were individual generating plants installed at each mine.

Interest naturally centers in the ingenious mining machinery which makes this type of installation possible. Each individual coal puncher, built by the Pneumelectric Machine Co., Syracuse, N. Y., is a complete power unit, as shown by the accompanying illustration. Comprised within a single frame is a series wound motor and a compressor cylinder. By a novel arrangement of gears the circular motion of the motor is transformed into the straight line motion of the first or primary piston which is attached to the transmitting mechanism. In the same cylinder is a second piston connected with the pick, but having no mechanical connection with the first piston.

Under the influence of the air which is compressed by the first piston, and delivered through open ports controlled by the movement of the compressor piston, the second piston is driven alternately backward and forward, but always prevented by the air cushioning from striking at either end of the stroke. As the maximum amount of power is required only when the air is being compressed during the backward stroke of the motor driven piston, and during the control of the machine, that required by the electric motor is uniform regardless of the character of the material in which the machine is working. The piston diameter is 6¼ in., carrying a final pressure of about 80 lb. in the compressing cylinder, which has been found best for operation. The motor runs at 3 speeds, 180, 160, and 140 strokes a minute, the power input never exceeding 7.5 hp.

Operation of the machine is as follows: The pinion B on the end of the armature shaft A engages with the main driving gear C. Through the medium of the internal gear F, the crank pinion E and the crosshead H, the rotating movement of the armature is changed into the reciprocating motion of the piston rod I and the piston J. The latter or rear piston, which is driven by the motor, compresses air on its backward stroke, the front piston K, with which it has no mechanical connection, follows simultaneously because of the vacuum produced by the recession of the piston J. Air is coincidentally admitted to the front side of Piston K through the port R.

On the rear side of piston J, the next to the motor, the air is compressed and just at the end of the stroke is admitted through large bypassages to the space between the 2 pistons. As a result the front piston is forced forward exactly as in any compressed air coal cutter with the absence of valves. During this stroke air is drawn into the cylinder behind the piston J through the main inlet valve O. On its forward stroke the air in front of the driven piston K escapes through

the port R, but after the piston has passed and therefore closed the port a sufficient amount of air remains to cushion the blow and prevent damage to the front cylinder head.

This cushion air may leak somewhat, and to prevent an insufficient supply remaining, which would have the effect of producing a partial vacuum in this space and holding the front piston on the return stroke, a small inlet valve R is placed in the forward part of the cylinder to allow air to flow in under these conditions and before the open port is passed.

After the front piston K has made its forward stroke the rear piston J follows, mechanically driven as before, and would compress the air which has just

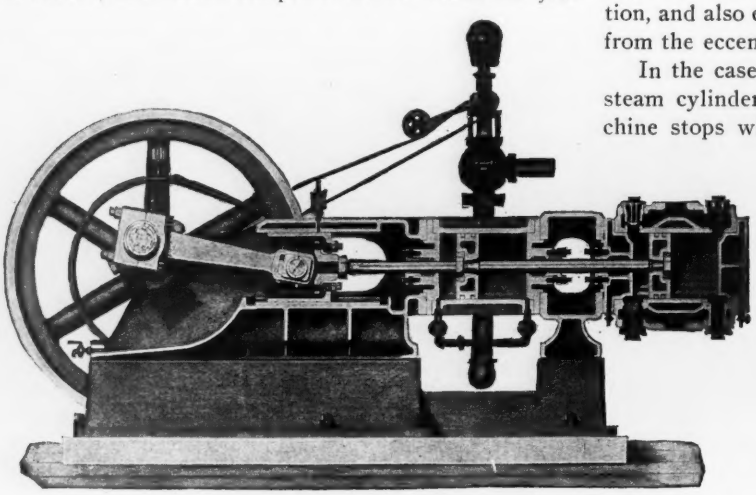


FIG. 1. SECTION OF SINGLE STEAM-DRIVEN AIR COMPRESSOR

caused the stroke of the front piston and remains between the 2 pistons, but for the so-called vacuum valve S, which allows all air between the pistons above a certain pressure to escape to the atmosphere. The placing and action of this prevents the 2 piston faces coming together.

NEW AIR COMPRESSORS

In a complete line of air compressors as built by the Thos. H. Dallett Co., of Philadelphia, Pa., are found many excellent and unique ideas in compressor design. These compressors incorporate the essential features of having all parts requiring adjustment or renewals readily accessible, employing only the best material and workmanship throughout, and using a liberal amount of metal, scientifically placed, to insure rigidity in operation.

The frame is of the open fork center crank type, graceful and pleasing in outline, and of an especially massive and rigid design to obtain on each size compressor a greater range of capacity by substituting, when desired, a cylinder of the next larger size than the standard to operate at 100 lb. pressure.

All steam ports are short and direct and of the proper area. The clearance has been reduced to a minimum, giving an appreciable saving in steam consumption. A plain D balanced slide valve is used on the small and medium sized machines; the Meyer balanced adjustable cutoff valve being employed on the larger machines. To provide efficient heat insulation all steam cylinders are lagged with mineral wool and neatly jacketed with planished sheet steel.

The rocker arms on all valve gears are provided with means for adjustment, doing away with all wabbly movement and unnecessary lost motion.

The governor pulley is situated on the end of the shaft outside of the flywheel on the single steam machine, thus bringing the flywheel as close to the bearing as possible, in accordance with the best construction, and also eliminating all possibility of oil or grease from the eccentric getting on the governor belt.

In the case of duplex compressors with compound steam cylinders a difficulty has been that if the machine stops with the high-pressure side on the dead

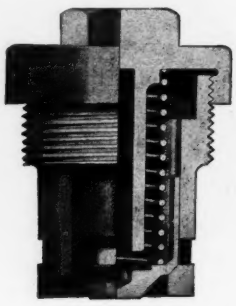


FIG. 2. DALLETT AIR-DISCHARGE VALVE

center, which occurs frequently, it will not start automatically, due to the fact that but one side, the high-pressure, takes steam from the line. This trouble has been overcome by using a reducing valve of standard make, which reduces the live steam pressure for use in the low-pressure cylinder, so that if the high-pressure side stops on the dead center, live steam is fed to the low-pressure cylinder through the reducing valve, starting the compressor.

The air and steam cylinders are tied together and held in position by means of an internally flanged tie or distance piece. On the smaller sizes this piece supports the air cylinder, but on the larger sizes the air cylinder is supported on a pedestal, while the tie piece is of circular design without the foot piece. Ample openings are provided on each side of the tie piece to allow adjustment of the stuffing boxes and tightening the cylinder stud bolts.

The valve cage cap acts as a lock nut for holding the cage in place after it has been screwed on its seat in the cylinder. It is provided with a hexagonal projection and the same wrench can be used here as on the valve cages. In the case of a compound machine, corrugated copper gaskets are placed under the valve cage caps on the high-pressure cylinder to insure

against any leakage, as the discharge pressure from the low-pressure cylinder is constantly at these joints.

The valve proper is a special alloy hardened steel, with seat and stem ground to gage. The valve spring is of phosphor bronze, and of the right proportion to give the valve an easy opening and a quick closure.

On the Dallett valve the spring holder comprises a split taper ring set into a recess on the valve stem, and held together and tight to the stem by means of a solid taper ring slipping down over it. The hammering of the valve on its seat tends to tighten the spring holder on the stem instead of driving it off, due to the action of the taper.

The discharge valve is of the automatic poppet type contained in a valve cage of malleable iron, the method of seating in the cylinder and locking to its seat being identical with that of the intake valve. A projection or boss has been provided on the valve

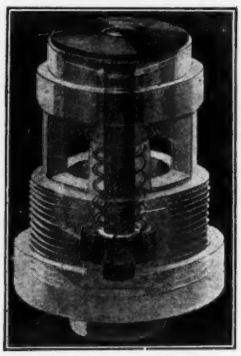


FIG. 3. SHADOW VIEW OF AIR INLET VALVE

cap, which acts as a positive stop for the valve when it has reached a lift, giving a full opening area, and does away with fluttering. This same projection on the cap also acts as a spring guide for the valve spring.

The discharge valve, light and of ample area, is of the same material as the intake, having all wearing surfaces ground to gage.

The intercooler plays an important part in economical operation of a 2-stage machine. The Dallett intercooler is of large cooling area, employing the return flow type of water circulation, using baffle plates to deflect the flow of the air and aid in its effectual contact with the cooling tubes. This method is very efficient in reducing the temperature of air between stages to approximately the original temperature, thus tending to reduce the final or discharge temperature and also the horsepower required for a given capacity. The nest of cooling tubes may be removed intact from the intercooler box without disturbing any of the piping, as unions are supplied to obviate this feature. The intercooler is supplied with pop safety valve, pressure gage and drain valve.

FIG. 4. DALLETT CROSSHEAD

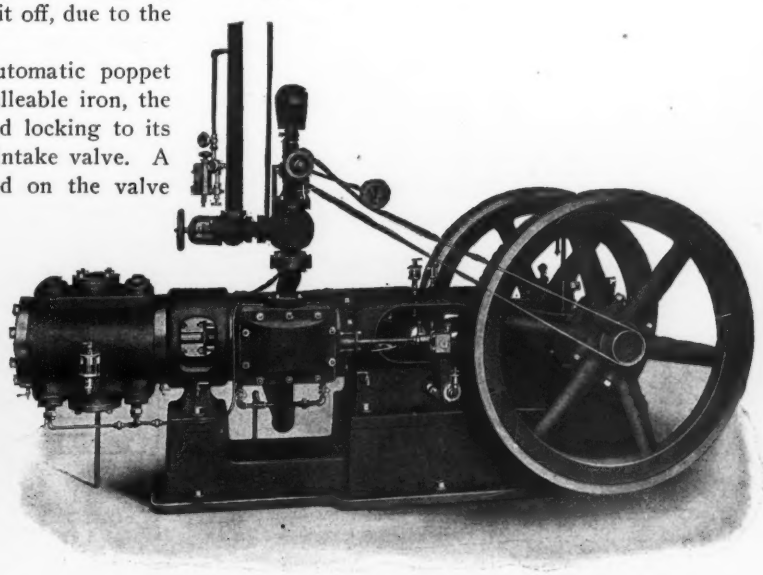


FIG. 5. SINGLE STEAM-DRIVEN COMPRESSOR, VALVE-GEAR SIDE

In a compressed air plant the demand for air is often of such an intermittent character that automatic regulation of the supply of air in accordance with the demand becomes a necessity. Belt driven machines are provided with an unloading device, which automatically unloads the air cylinder. When a certain determined pressure is reached in the air receiver, one or more inlet valves at both ends of the air cylinder are held open and the load is taken off the compressor, allowing it to run light until the pressure drops in the receiver, upon which the valves are released and air compression is resumed.

On the steam machines a combined speed and pressure governor is used, which unloads the air cylinder exactly the same as on a belt driven machine, and at the same time controls the speed, allowing a single steam machine to just turn over when unloaded, and bringing a duplex or compound machine to a dead stop. By this means a great saving in steam is effected and the wear and tear on the working parts, as in the case of continuous running machines, is reduced.

The compressors described are built in sizes from 8-in. stroke up to and including 16-in. stroke, and give a range of capacity from 79 cu. ft. of free air per minute to 1,200 cu. ft.

LETTERS FROM ENGINEERS

Send us descriptions of ways of doing new things, and new ways of doing old things. Rough pencil sketches and letters are all right; we will fix them up for the printer. All accepted contributions will be paid for when published.

Tracing Faded Blue Prints

The accompanying illustration shows a drawing board made for the purpose of tracing blue prints. The top of the drawing board is made with plate glass inserted in an opening as shown in Fig. 1. The sides are made high enough to take a V-shaped track, upon which to slide an electric light with reflector as shown in Fig. 2.

It is a very simple operation to use the frame for almost any size blue print because when a print that is too small to be tacked to the wooden edge is to be

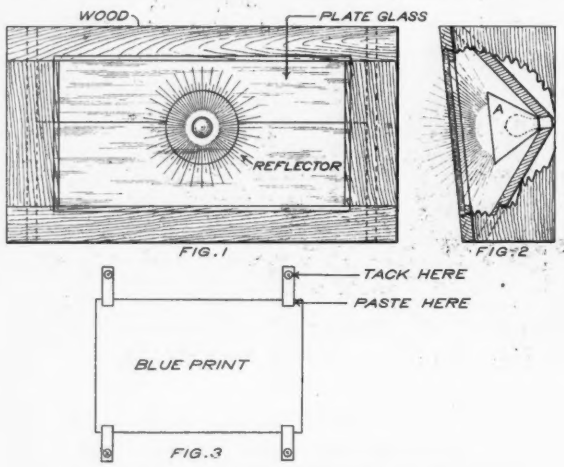


FIG. 1. GLASS TOP DRAWING BOARD
FIG. 2. END VIEW OF DRAWING BOARD
FIG. 3. METHOD OF HOLDING SMALL BLUE PRINTS

traced all that is necessary is to paste 4 strips of paper to the edge of the print as shown in Fig. 3.

A common 16 candle power light and a reflector as shown at A in Fig. 2 is all that is necessary for light to make tracings of most prints. But if the print to be traced is an expectionally bad one it is a good idea to use a stronger light.

Another good scheme for making tracings of blue prints that are too badly faded or blurred to trace is to ink them with a water proof ink. Then wash the print in a solution of washing soda and water, which will remove all the blue and leave the ink lines intact. Of course it will be necessary to experiment with the strength of solution necessary to remove the blue on each print as different prints take different strengths of solution. A good proportion to start experimenting with is ⅛ lb. of soda to 1 qt. of warm water. Now take a small piece of the paper being used and after drawing a few ink lines on it try it in this solution. If it removes the blue and leaves the ink intact it is of a good strength and the whole print can then be washed without fear of losing the ink lines. After washing with the solution rewash with clean cold water and dry between newspapers.

John M. Sewell.

A Home Made Feed-Water Heater

The accompanying Figs. 1 and 2 show the construction of a feed-water heater of the open type which I had made from an old return tubular boiler which keeps the feed water at from 205 to 211 deg. F. and which will pay for itself in a very short time by re-

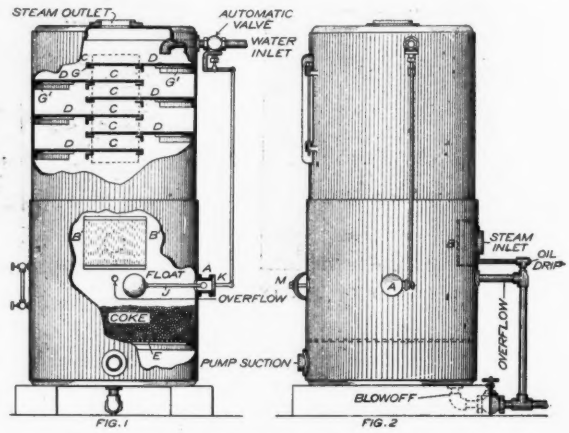


FIG. 1. FRONT ELEVATION OF FEED-WATER HEATER
FIG. 2. SIDE ELEVATION OF FEED-WATER HEATER

ducing the coal consumption. Figure 1 shows a sectional elevation facing the front or cleaning-out door. As will be seen it consists of 6 pans or shells C, which are supported by angle irons G, G′. Irons G are riveted to the front and back of the shell and extend back from the cleaning door. The pans are in 2 pieces. The sections C are cut narrow enough to slide in the door as shown by dotted lines, while the sections D are cut to fit the shell and rest on angle irons G′. These pans can be cleaned without removing, as they can be scraped off through the door.

The exhaust steam inlet is shown on the right in Fig. 2, also an oil separator shown by dotted lines B. This consists of a piece of sheet-iron bent as shown and riveted to the shell over the steam inlet; it is closed at the top and bottom but is open on each side at B′ B′ Fig. 1. The dotted lines shown in Fig. 1 on the separator represent 1-in. angle irons riveted in a vertical position, which separates the oil from the

steam, and drains it down and out through the oil pipe as shown in Fig. 2.

At E is a perforated plate which is supported by an angle iron riveted around the inside of the shell. This plate is in sections small enough to be put through the manhole M. Below this plate is the suction to the boiler feed pump, also the blowoff. On top ot the plate I put a layer of coke for a filter.

The construction of the float is shown in Fig. 1 at A. I put a 4-in. flange on the shell and screwed a short 4-in. nipple into it with a cap on the end. Into this nipple and at right angles to it a hole was drilled and tapped out to take a stuffing box H Fig. 2, which was removed from an old valve.

For the stem I used a piece of pipe with a tee on the inside of the 4-in. nipple, into which a piece was screwed. By using pipe for this, if the float should leak, it will show at once by running out through this pipe where the lever K is fastened on.

The heater that I built was made from an 18 by 72 in. boiler by cutting off one sheet, which left the heater about 12 ft. high. I used a 10-in. exhaust inlet, 2.5-in. water supply and a 5-in. pump suction. This heater would raise the water from about 70 deg. to 210 with very little exhaust steam. New heads can be used, or the old ones, by riveting a plate over the tube holes. R. L. M.

Unequal Cutoff With the D Valve.

Your correspondent Z. B. R., on page 64, December issue, has discovered that "all is not gold," etc.—in valve gear design.

The inequality described is not of deliberate intent on the part of the designer but is due to the fact that the poor man could not help himself.

Figure 1 shows the distorting effect of what is called connecting rod angularity; this distorted motion is present in all reciprocating engines, using a connecting rod between the crosshead, and crankpin and is the cause of the discrepancy noted.

Let the circle A be the path of the crankpin, B and C the dead centers and B′ and C′ the limits of the crosshead travel, in which case B′ B and C′ C must equal the length of the connecting rod.

If we put the crank on the top quarter at the point D, we will find the crosshead at D′ and not at F, as would naturally be expected at first thought.

In other words, while the crank has covered exactly half of the distance between the dead centers the crosshead has passed through considerably more than half of its travel.

It is obvious that the crank shaft must have an even, regular motion during all parts of its revolution and that all parts integral with it, including the eccentric, must have the same regular motion, and as the eccentric rod is always of much greater length compared to the throw of the eccentric than the connecting rod, compared to the throw of the crank, the distorting effect is much greater at the crosshead than at the valve.

If an engine having the proportions used in Fig. 1 should have its valve adjusted for equal lead and to cutoff at approximately half stroke, the real cutoff would be at about 0.6 on the head end and 0.4 on the crank end.

It does not pay to use a connecting rod of sufficient length to obviate this distortion, so the designer does things to the valve and sometimes to both valve and seat, to even things up as best he can.

Figure 2 gives actual dimensions of the valve and seat of a well known 12 by 16 in. slide valve engine. It will be noted that the ledge of the valve, at the left or crank end, is 1 31/32 in. wide, while the other end measures only 1 23/32 in.; this apparent fault in design evens up the release and compression when the valve is so adjusted that the admission and cutoff are equalized as nearly as may be possible.

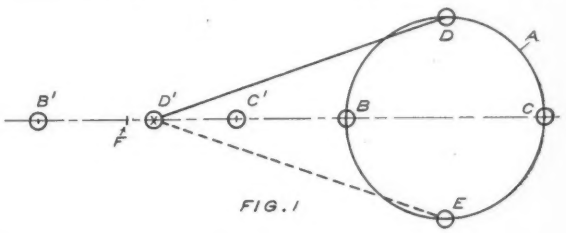


FIG. 1

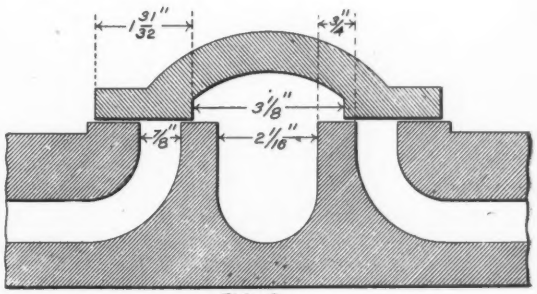


FIG. 2

FIG. 1. VALVE DIAGRAM
FIG. 2. D-VALVE SHOWING DIMENSIONS

To sum up, no single-valve reciprocating engine can be so arranged that the admission and cutoff will be equal at the same time, unless some sort of equalizing gear be interposed between the excentric and the valve.

A. Maun.

Chlorine and Boiler Explosions

I find Practical Engineer always interesting and up to date, and have on file almost every number for the last 4 yr. The January number is fine and has many interesting and worthy articles.

In one article it is stated that the chlorides produce corrosion. An idea came to me several years ago which may set some of the readers thinking.

I believe that in some manner, which could no doubt be shown by formulas, in case chlorides are present in the feed water, free chlorine is the result of certain reactions which take place within the boiler, also free hydrogen. This being the case, the danger is

not only from the fact that these 2 elements may combine and produce hydrochloric acid (HCl) and cause corrosion, but there is a greater danger.

Now this is where many of the readers will scoff at my idea; yet it is a fact that it is almost impossible to combine these 2 gaseous elements in the dark, but the rays of direct sunlight will cause them to unite with a violent explosion. This was demonstrated to me while experimenting with chlorine in high school, where it fell upon me to try the experiment of mixing hydrogen and chlorine. Having procured a heavy glass jar, wide mouthed and also wrapped with a heavy towel, I put a quantity of each gas in the jar and then placed it on a board and shoved it out of the window into the sunlight. Immediately there was an explosion and the jar was shattered into fragments. Had it not been for the towel many of us might have been seriously hurt.

Now with these 2 elements is it not possible to have this same explosion occur in a boiler? If it is possible, then this may account for many of the mysterious explosions which occur where no fault can be discovered in the plates or other parts of the boiler.

Several years ago I read an article in some paper in which some man tried to explain how it was "gases," not steam, that exploded boilers. But the idea was carried that it was ignition from heat, that caused the explosion; as the article was not written by the man himself, it may be that he referred to this same combination.

I am expecting many theories to be brought out, and it would please me and no doubt a great many others to hear from some practical chemist on this subject, but he must consider every phase of the matter—heat, changing of elements in forming new compounds, electrolysis, etc.

This subject may not interest some, yet I believe that it will be a benefit to many, because it will show how many times you could make use of a little knowledge of chemistry. Very few engineers can read an article trying to explain the combination formed by different elements and fully understand it. Many have no idea what the word "elements" means. Many do not understand the simple formulas H_2O or CO or CO_2 which we see so much in our journals, yet they are simple if one would only read the first few pages in any good text book on chemistry.

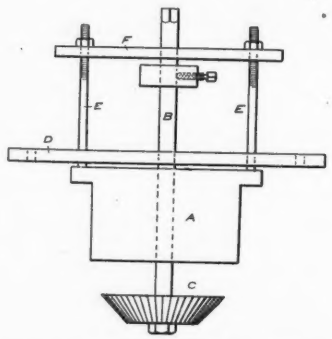
My advice to you, brother engineers, is this: If you have any chlorides to deal with in your feed water, shade your gage glass from direct sunlight.

J. M.

Reseating Pump Valves

Some time ago the valves and seats on my 12 by 7 by 12 pot valve type feed pump became badly worn, causing the pump to run a great deal faster on account of the excessive leakage past the valves. The pump has 16 3-in. valves, with the seats on a level of 45 deg. and all pressed in, so instead of pulling them out and running a chance of springing them in driving them in, I had a reseating machine made, and reseated them in place. The valves were taken to the machine shop and faced up in a lathe.

The guide block was made to fit the valve chamber and is bored for the shaft B which carries the cutting tool C. The strap D has a slot in each end to go over the valve chamber studs and holds the guide block in proper position. The plate F is held down on the collar, which is fastened to the shaft by a set screw,



APPLIANCE FOR RESEATING VALVES

by the studs E E on each side; these studs keep the cutter from rising off the seat. The shaft and cutter are turned by a tap wrench, which fits the square end of the shaft.

After being reseated by this machine, which takes only a short time, the valves were ground in with emery. To do this I sawed a slot in the top of the valve stem, took an old broken file, ground the end down to fit the slot, put it in a breast drill and a few turns gave the valve a good seat. I use this same machine on the blowoff valves, except a different cutter, as the seats are flat. J. C. Hawkins.

Experiences With Compressor Valves

During the 4 months ending February 1, 1909, I have kept careful record of every compressor with Meyer cutoff valve coming under my observation and of many different makes. During this time I have paid particular attention to the point of cutoff at which these valves were being operated. Of 242 compressors inspected during this time I found only 52 carrying their cutoff at the proper point for the load, speed and steam pressure. There were 14 upon which some attempt had been made to shorten the cutoff. The remaining 186 were carrying their cutoff at 0.75 stroke and were really not getting as good steam economy as they would have secured from a properly designed D valve. Is the reason for this ignorance or laziness? I believe that in many cases it is both, especially in the case of the straight line compressor. As we all know the terminal air pressure being constant the energy, barring mechanical friction, is the same per revolution whether the compressor is running at 40 or 140 r. p. m.

In the straight line compressor at the slower speeds the inertia of the flywheels is not so great and it is necessary to cutoff a little later than at the higher speed. But if the steam pressure is reasonably high, the governor employed should take care of this change.

Unless the straight line compressor is relieved of its load before shutting down, the compression of the air in the air cylinder will cause it to stop at a point later than the point of cutoff. Then when it comes time to warm up the compressor again, the engineer has got to work his compressor off the center by hand and to help do this he lengthens out his cutoff in order that he may get the assistance of the steam in turning the compressor over. After getting up speed he usually gives attention to his oil cups to see that they are feeding properly, and by that time has forgotten all about putting his cutoff back to the proper point. In a few weeks he has forgotten that the machine is fitted with adjustable cutoff. At the end of the first month after the Meyer valve compressor has been installed when the coal bills are compared the manager nearly has a fit and says unprintable things about the man who sold him the compressor, for, if it is of fairly large size, the increased coal bill has been greatly in excess of what the builders said it would be and the compressor gets all of the blame, when the blame should be put upon the engineer's ignorance, laziness and lack of pride in keeping down operating expenses.

A few years ago a straight line compressor of 24-in. stroke together with boiler for operating was purchased by a Pennsylvania contractor. The erecting engineer left both in good shape, boiler steaming easily and compressor cutting off at ⅓ stroke. In less than 2 weeks the manufacturers received a telegram reading, "Send man. Impossible to keep sufficient steam pressure to operate compressor." The same man who erected the compressor was sent and in 10 minutes after his arrival it was necessary to close dampers to keep the safety valves from blowing.

A few weeks ago the writer was sent to a plant of 2,000 hp. capacity, which had in operation a compressor with duplex compound air cylinders and duplex compound steam cylinders. Complaint had been made that the high pressure crank pin and main bearing were giving considerable trouble by heating. As is usually the case, the position of cutoff was looked to first. I found that the high pressure cutoff was at ⅝, and low pressure cutoff at ¾ stroke. The cutoffs were adjusted as nearly as possible without an indicator, to balance up the load between the 2 cylinders, and the pin and bearing immediately commenced to cool down and in 2 hr. were running the same as the low pressure side.

Look to your cutoff and run as short as possible and adjust to balance loads and thus prevent undue strains in duplex compound compressors and at the same time save money by getting the effect of compounding. Max.

A Badly Wrecked Engine

On Dec. 15, about 6 o'clock, during the rush usual at that time, an 800 hp. tandem-compound Watts-Campbell condensing engine at the power house of the Trenton Street Railway Co. met with an accident which resulted in the complete destruction of the high-pressure cylinder and a badly cracked low-pressure cylinder head. The piston rod was pulled out of the crosshead, which was damaged beyond repair.

According to the report, the night engineer was at the opposite side of the room, when, hearing an unusual noise, he turned toward the engine; at the same instant the escape of steam into the room nearly knocked him down. It was necessary to go to the boiler room to shut off steam, but fortunately none of the generators were damaged.

There are 2 possible causes for the accident, which occurred, as there was no visible evidence of water in the cylinder. One is that a crosshead shoe became broken loose and getting between the crosshead and cylinder stopped the former and the pressure behind and momentum of the pistons and rods was sufficient to cause the crosshead to break at the middle of the keyway, allowing the pistons to strike the cylinder heads. The positions of the heads and pieces of the crosshead support this theory fairly well, but as there is no present appearance of any damage to the crank pin or connecting rod, it seems most likely that the rod simply pulled out of the back of the crosshead. The break has the appearance of an old crack, as it is somewhat discolored. The engine having had a similar accident before, due to water, it seems very probable that a crack was started then, finally giving way under the heavy load. Harry H. Yates.

Setting the Expansion Valve; Feeding Compound to Boilers; Effects of Compression

In the December issue of Practical Engineer John Nash has a good article on Setting the Expansion Valve and in commenting on a former article on the same subject published in the July issue, Mr. Nash says: "He says, 'Too wide an opening will allow the liquid to pass through without evaporation,' and again, 'The passage of unevaporated liquid may sometimes be dected by the ear.'" Now, in a certain sense this former writer may be right or he may be wrong, depending upon the construction he intends the reader to give his article.

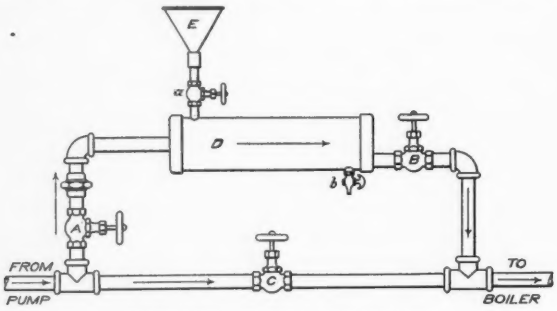
If he means, as I think he does, that too wide an opening of the expansion valve will allow the liquid to pass through the evaporating coils, and even down to the machine without evaporating, he is right, as this is a common occurrence; and, furthermore, "The passage of unevaporated liquid may sometimes be detected by the ear;" that is, passage through the evaporating coils, or the machine, is also right, as this can easily be done by an experienced ear.

But, on the other hand, if he means that no liquid should pass the expansion valve at all, nor be allowed

to enter the evaporating coils, then, as Mr. Nash says, "We don't get the benefit of its latent heat properties," as this would be entirely expended at the point of expansion, viz: at the valve. It is absolutely necessary to permit the liquid to pass the valve and enter the coils, as refrigeration is brought about only at the point of expansion, but the valve must have only a very small area of opening, and, for this reason, a valve should be selected capable of very fine adjustment.

One of our very best authorities on mechanical refrigeration has this to say of the expansion valve: "It is a peculiar valve, admitting of very fine adjustment, so as to enable the engineer to admit the required amount of liquid to the expander, and no more."

C. H. T. gives some good ideas in the December number on the above subject, and his manner of feeding the compound is all right. But it sometimes hap-



COMPOUND FEEDER FOR BOILERS

pens that feeding compound through the pump will cause the pump packing to deteriorate, and especially so in the case of soda ash being used as a solvent, also caustic soda as well as some other solvents.

To avoid any possible trouble from this source the method of feeding as shown in the illustration has been found to be very satisfactory, although it does not admit of the continuous feeding of the solvent.

With valves A and B closed and valve a open the cylinder D is filled with the compound through the funnel E, and while the boiler is feeding straight through the pipe and valve C. After the cylinder is full, or contains as much as is desired to use at any one time, close valve a, open valves A and B, then close valve C, when the solvent will be fed to the boiler along with the feed water. Cylinder D can be drained by means of the pet cock b.

E. G. Tilden has an article in the December issue, referring to a former article by A. R. M. published in the September number, under the above title. He gives 2 different indicator diagrams and asks: "Who can tell us why more compression is realized in Fig. 1 than in Fig. 2, assuming a constant exhaust closure and the same back pressure?" For the simple reason that, according to the different diagrams shown, he has the same valve setting for different heights of the counter-pressure line, when it should be different in an engine of the 4-valve type when compression is constant regardless of variations in the load.

Set the valves a little later for diagram Fig. 1.

J. L. Bradshaw.

Feed Pipe Location

Replying to S. B. in the December, 1908, number, I do not think the law ought to have everything to do with the location of the feed pipe, but there ought to be a law requiring more than 1 feed pipe to a boiler. The writer gives a sketch of a boiler feed, Fig. 1, somewhat similar to that of Mr. Westerfield's, in the November, 1908, number. In this case the location of the feed was changed slightly; that is to say, raised or

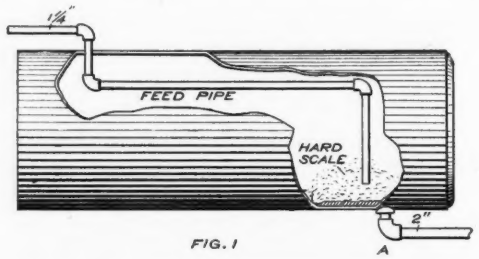


FIG. 1

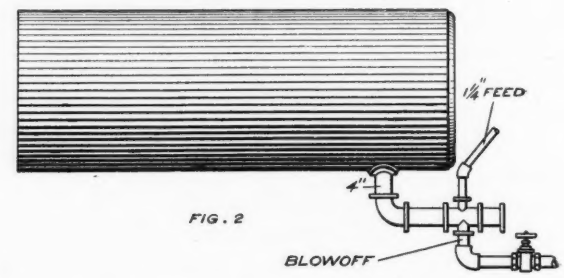


FIG. 2

FIG. 1. ARRANGEMENT OF FEED PIPE
FIG. 2. COMBINED FEED AND BLOW-OFF PIPE

lowered, but there would be a hard scale gather on the plate or tubes, or both, and this scale would have to be scraped off every time the boiler was washed out. Every month or so some of the feed pipes would have to be renewed, as it would become full of sand holes outside of the boiler, so that by the end of the year there would be a new feed pipe altogether.

The writer was at work 3 yr. where feeding was done as shown in Fig. 1, and did not know what it was to see a boilermaker or have any work done. There are some things that I do not like about the arrangement shown in Fig. 1—the blowoff pipe at A gave way, just as the fire was being cleaned, but nobody was hurt. There were 5 of these boilers, and things were lively in the boiler room, as they were all running at the time of the accident.

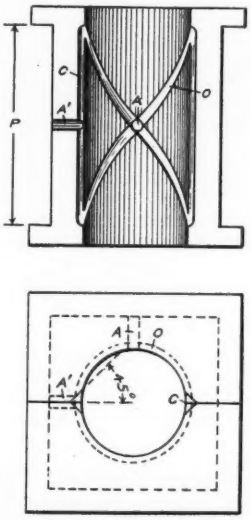
S. B. said that he would rather have the blowoff opened wide unbeknown to him than to have a feed pipe break. I would rather have anything happen than that, as I have had a little of everything in that line such as the breaking of a feed pipe, blowoff, and water column pipe, when running with hot fires.

The only disadvantageous feature which I see in the arrangement for feeding the boiler as shown in Fig. 2 is that a boilermaker is required to repair the tubes about every 3 mo. and the feed pipe will fill with hard scale, so that no water will pass through it. When this occurs the pipe is removed, cleaned out and put back in the same place. The writer knows of an instance in which 1 pipe has been used for this purpose for 5 yr. and no scale has been found in the boiler up to the present time. I would like to know the opinion of other readers in regard to this arrangement.

C. W. B. McC.

Replying to the criticism of S. B. on page 51 of the December issue of the Practical Engineer, will say that the criticism does not apply to me at all, as nothing is said of the article proper, but the criticism is directed at the cut that was inserted in the article, I presume by the editor, to indicate in a general way the application of the plan I suggested for introducing the feed water into the boiler. It is, therefore, not up to me to defend the cut, but I do not think that there is the danger of "emptying the boiler" and killing people with this layout that S. B. imagines. I do not, however, indorse the plan shown in the cut. I have often seen something similar to it, but have never installed anything like it myself. I prefer to have the discharge outlet above the top row of tubes as suggested by S. B., so that we have nothing on which we could base a discussion.

William Westerfield.



OIL GROOVES

Improved Oil Grooves

The accompanying sketch shows improved oil grooves, suitable for new and old bearings, which give the best results on lubrication, safety and economy, easier and quicker made than any other kind.

On both sides of the half bearing C is a 45 deg. declivity made in 1 cut, using the cylindrical side of a vertical end mill cutter about 0.5 in. in diameter. O is the oil groove cut in 2 times on the lathe; it is a helicoidal curve of which the pitch equals 2 times the length of P. The time required to make these grooves is about 2 or 3 min. to cut C off and 5 min. to cut O, the oil ways, with a special boring tool. The distribution of oil is continual, safe and economical when this method of grooving is employed. C. Labbe.

Diagram From a 40-Year-Old Engine

On page 41 of the December issue I saw an indicator diagram taken from an engine that has been run for 37 yr. every day except Sunday, so Mr. O. W. R. says and shows that the engine has been taken care of. The diagram is very good, indeed.

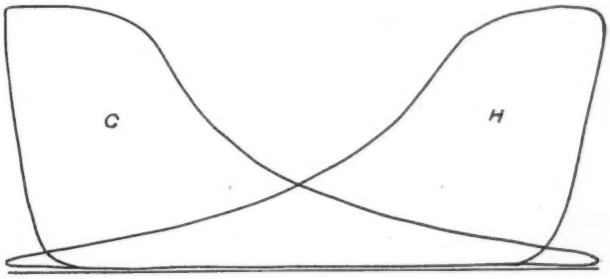


DIAGRAM FROM A 40-YEAR-OLD ENGINE

I wish to be permitted to show another indicator diagram, taken from an engine that has been run for over 40 yr. The engine is a Buckeye 14¼ by 24 in., running at 104 r. p. m. This engine has been taken good care of ever since it was taken from the shops at Salem, Ohio, and is good for many years of service yet, if given good care, which I think it will get, for the people think lots of the old engine, and, of course, it has been there long enough to vote.

This shows the use of the indicator, too, for this engine has the indicator on it very often and it is kept at its best. J. C. Kahl.

THE UNITED STATES GEOLOGICAL SURVEY has recently taken up the question of the utilization of peat and has appointed peat expert Charles A. Davis, formerly of the University of Michigan. Mr. Davis has prepared several papers on Marl and Material for Cement, and also an exhaustive treatise on the subject of Peat and the Peat Resources of Michigan. In his new position he will be employed in testing large samples of peat in the latest types of producer gas engines, and will also investigate the production of ammonia sulphate from peat by using superheated steam. Peat is capable of comparatively rapid growth and can be developed in marshes which are practically useless for other purposes, so that this source of fuel is likely in the future to be one of the important resources of the world when the coal supply has been depleted.

MAKING ICE BY MACHINERY AT THE EDGEWATER PLANT

(*Continued from Page 164.*)

ft. long by 30.75 ft. wide by 63 in. deep and containing 40,000 ft. of 1.25-in. ammonia pipe, placed in vertical sections between the rows of cans; the tank is fitted

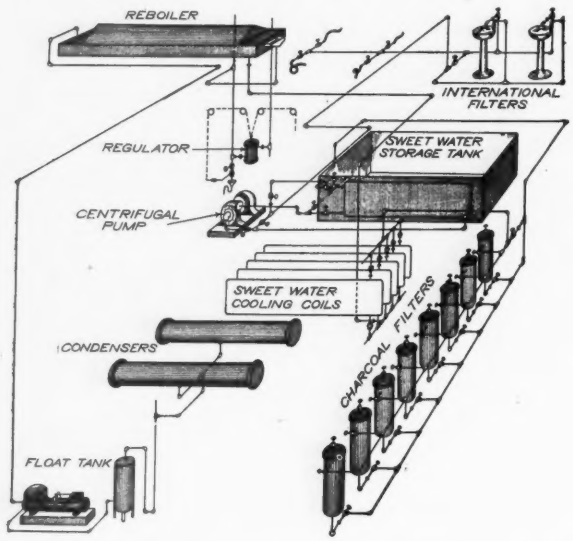


FIG. 5. DISTILLED WATER PIPE LINES

to accommodate 676 ice cans. Each tank is divided in the center by a partition running the full length of the tank with an opening at the top at one end and at the bottom at the other for the circulation of the brine.

Two brine circulators are employed in each tank.

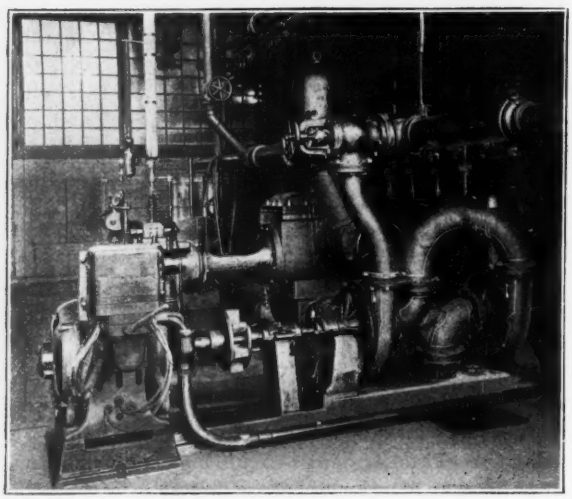


FIG. 6. SERVICE PUMPS FOR WATER SYSTEM

These circulators are of the standard York type, being specially designed centrifugal pumps. In this plant the circulators are placed vertical, each being direct driven by a 3-hp. Westinghouse motor.

Two Curtis pneumatic hoists are employed, the air being supplied by a Westinghouse air compressor of the locomotive type, with an auxiliary connection to a motor-driven air compressor. These hoists are capable of lifting 2 400-lb. cans and conveying them to any desired part of the room.

In this room are also located 2 dip tubs and 2 can dumps, which are shown in Fig. 8.

Storage Rooms

The total storage capacity of this plant is 40,000 tons. Room No. 1 is used for the handling of the ice

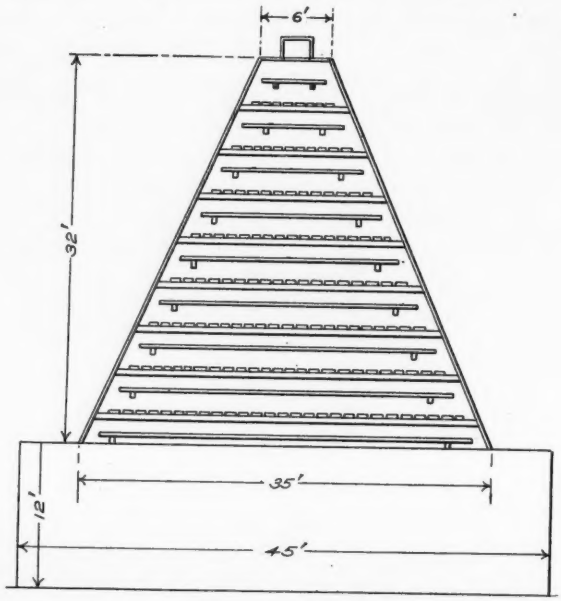


FIG. 7. COOLING TOWER ARRANGEMENT

and is sufficiently large to take care of 125 tons daily. In this room are located the brine coolers which consist of 2 sections, each of 12 double pipe, 2 and 3 in. pipes 18 ft. long, each capable of refrigerating 15 tons in 24 hr.; 2 centrifugal pumps, direct connected to motors and used to circulate the brine through the pipes in the storage rooms; and a brine tank.

Rooms 2 and 3 are used for storage, piped with 1.25-in. brine pipes of sufficient length to provide 1 ft. of pipe to 17 cu. ft. of storage room, making a total of 13,350 linear ft. of piping.

Boiler Room

It will be readily understood that a plant of this size requires a large amount of power. The steam generating system consists of a battery of 4 Erie City Iron Works return tubular boilers, 72 in. by 20 ft., each equipped with a Green chain grate, having a live surface of approximately 5 by 8 ft. These grates are driven by eccentric rods from a shaft belted to a 4 by 6-in. Wachs vertical engine.

The method of handling the coal consists in unloading it into a bin, from which it is elevated by a coal elevator of the C. O. Bartlett & Snow Co. make and conveyed into the hopper, the total capacity of which is 135 tons. The elevator and conveyor are driven by Fairbanks-Morse back-geared 5-hp. motors.

Ash Conveyor

For taking care of the ashes, a peculiar method was devised by Olson Bros. & Co., Chicago, and consists in dropping the ashes to pits beneath the boilers and

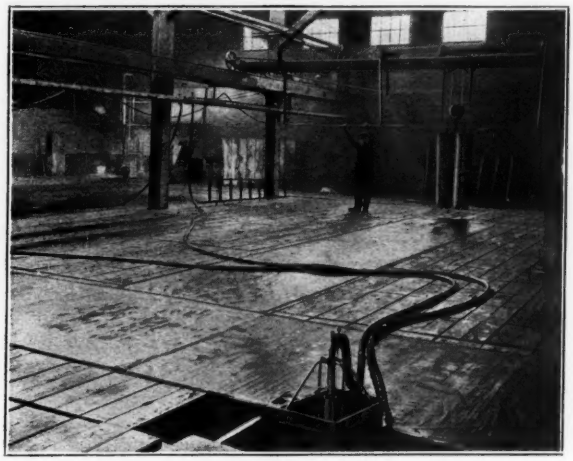


FIG. 8. GENERAL VIEW OF FREEZING ROOM

conveying them through 6 in. pipes to an elevated ash bin by means of an exhaust fan, which sucks the ashes through the pipe by a draft of air at a velocity of 2,180 ft. a minute. This device is shown in Fig. 10. Upon entering the bin, the ashes are sprayed with water, which settles the dust and allows them to fall to the bottom of the bin. The air passing around the baffle plate is drawn to the exhaust fan and out to the atmos-

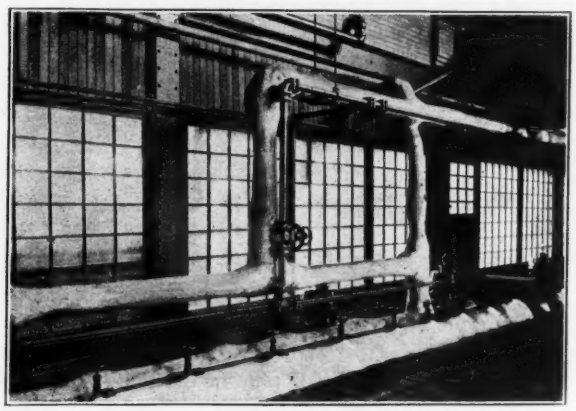


FIG. 9. BRINE AGITATORS AND AMMONIA PIPING IN FREEZING ROOM

phere, a Sturtevant exhaust fan, direct connected to a 40-kw. Fairbanks-Morse motor being used for this purpose. This bin is 8 ft. in diameter by 8 ft. deep, with a 45 deg. slope at the bottom. By operating a slide at the bottom the ashes fall into a wagon to be carried away.

Part of the cooling water from the condensers is used for feeding the boilers and is further heated by a Baragwanath open feed-water heater. It is then pumped to the boilers by 2 boiler feed pumps of the Marsh type, each 10 by 10 by 12 in., which also have connections to the city mains.

The stack is made of brick, lined with fire brick, 5.5 ft. inside diameter by 125 ft. high. The breeching connecting the boilers to the stack is round, made of 0.25-in. sheet iron, 6 ft. 4 in. at the larger end, reducing to 3 ft. 8 in. at the smaller end.

The regulation throughout the boiler room is done by hand, carrying the steam pressure at 120 lb. The

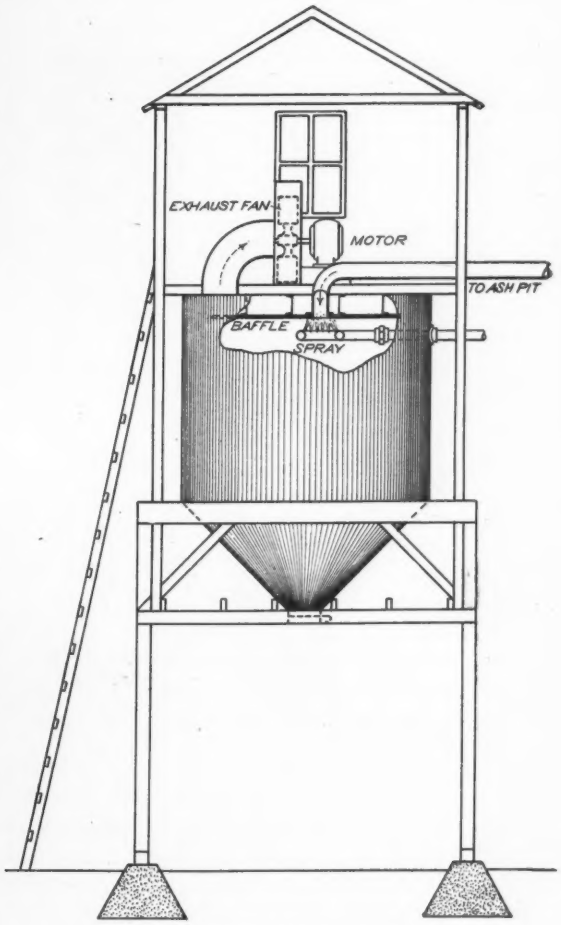


FIG. 10. ASH HANDLING DEVICE

method of feeding the boiler is through the blowoff connection, using a 4 in. pipe.

Engine Room

Every precaution has been taken in the design of this plant to eliminate the possibility of an entire shutdown. Nearly every piece of machinery employed in the engine room has an auxiliary which is capable of carrying on a large share of the work. The ice machines are 2 in number, both built by the York Mfg. Co., the main compressor having a capacity of 125 tons a day and consisting of 2 vertical compressors, 24 by 36 in., running at 49 r. p. m., single acting, direct connected to a Corliss horizontal type steam end, 32 by 36

in.. A sectional view of this compressor is shown in Fig. 11. The diameter of the shaft is 16 in. and the flywheel, 12 ft. in diameter, weighs 32,000 lb.

The second or auxiliary machine is of 15 tons capacity, 11 by 15 in., running at 66 r. p. m. and consists of 2 vertical compressors, single acting, with a Corliss steam end. The shaft is 7.5 in. in diameter and the flywheel weighs 5,000 lb., with a diameter of 5 ft.

All engines in this station are supplied with Crane live steam separators of the vertical type, insuring dry steam at all times. These ice machines are equipped with special ammonia stop valves and so piped that either one or both can be used at any time without interfering with the other.

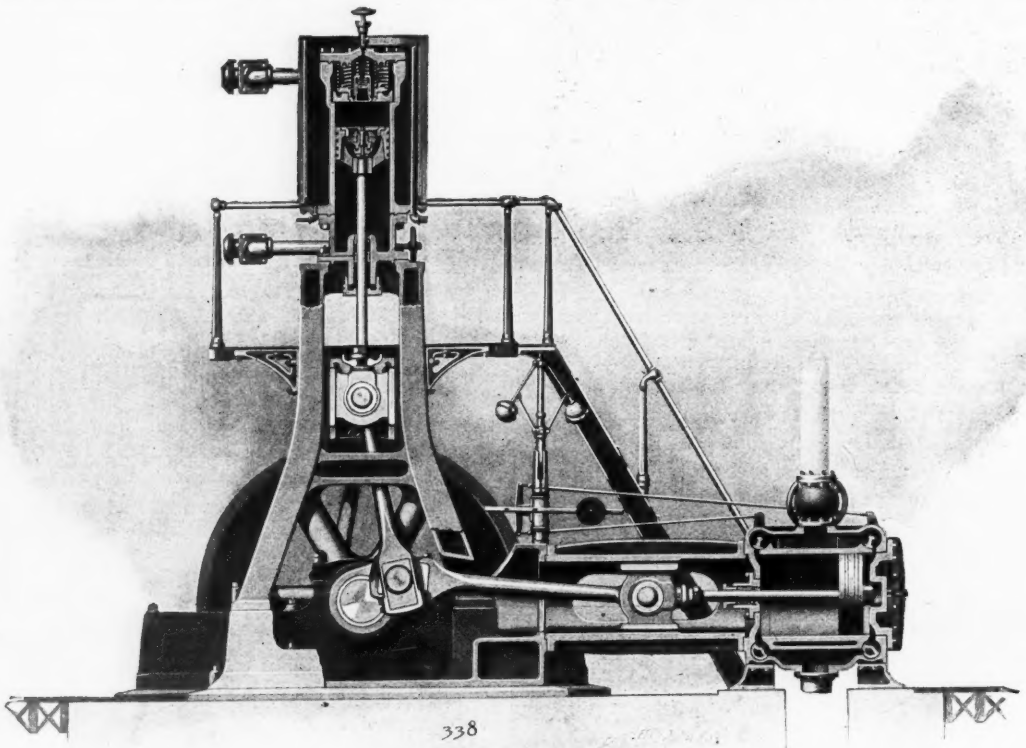


FIG. 11. SECTIONAL VIEW OF YORK ICE MACHINE

The main electrical generating unit consists of a Skinner automatic engine, 12 by 15 in., running at 277 r. p. m., direct connected to a Crocker-Wheeler alternator, of 75 kw. capacity, generating current at 240 volts, 60 cycles and 3-phase. The exciter for this generator is direct connected to the shaft of the engine and delivers direct current at 125 volts. This unit is capable of furnishing all electrical power used in the plant and the necessary current for lighting the entire plant.

An auxiliary engine and generator are installed, which consist of an Ideal engine, made by A. L. Ide & Sons Co., 11 by 14 in., of the piston valve type, belted to a Bullock alternator, generating current at 240 volts; it may be run in parallel with the main unit. The exciter for this generator is direct connected to it, delivering direct current to the alternator fields at 120 volts.

The switchboard consists of 2 panels equipped with Wagner Electric Co.'s instruments, together with the necessary switches connecting circuits leading to the various parts of the plant. For sychronizing the generators a Westinghouse sychronscope is employed.

Wiring throughout the plant is in iron conduits and as alternating current is used on all motors, there is little danger of electric sparks setting fire to the ammonia gas. Incandescent lamps are used in all parts of the plant with the addition of a few arc lamps in the engine and freezing rooms.

One of the most attractive features of the plant is the thorough system of pipe insulation. All the ammonia and steam pipe lines are insulated with Keasbey and Mattison 85 per cent magnesia pipe covering, which insures a minimum loss by radiation.

Three railway switches, from the Chicago, Milwaukee and St. Paul track, are conveniently placed for handling the ice, coal and other material used in the plant.

The chief engineer in charge is B. M. Kirker, to whom we are indebted for much of the information in regard to the construction of the plant.

MOTOR-BOATING promises to be more popular than ever during the present season.

OIL SEPARATORS

By William Shenton

If an engineer says that there is no perfect oil separator, it means only that his experience has been limited. Such separators are made, however, and it may be well to discuss just what the qualifications of a perfect oil separator are.

All separators of steam and oil, no matter what their forms are based on the principle of throwing out of the steam current the heavier particles of oil and water. The devices used to perform this are baffles in various forms, all designed to impart a more or less whirling motion to the steam, when the separation is performed by the law of centrifugal action. The same law is brought into action by the increase of size in the separator, the effect being in either case to force the heavier particles in a line tangent to the main current.

Those separators having small areas and imperfectly designed baffles inevitably catch some of the oil, but they are not effective appliances, and the prospective purchaser or engineer should see that the apparatus offered is constructed in a way to perform effective separation.

A separator constructed for steam service and performing work would come far from doing effective work when applied to oil separation, because, to perform the best service, different construction is necessary. On the other hand, an effective oil separator, correctly designed, would be the highest type of steam separator, because in an oil separator all the principles must necessarily be included in order to make it an effective apparatus. Broadly stated, these principles are separation and elimination.

Suppose that the separator is properly constructed so that separation or centrifugal action necessary has been properly applied; now, if these separated particles are not kept out of the current, they will be taken up again or be driven along the side of the separator and pass completely through.

The use of water introduced into the separator is expensive, and the spray introduces other difficulties which cannot be eliminated; it cools off the steam; it coagulates the oil, creating the necessity of often cleaning out the separator. No proper test of a separator using quantities of water can be made unless the added water is measured and the percentage of oil to water computed from the remainder. The writer believes that artificial water sprays may be considered ineffective and unnecessary.

The ideal separator may be defined as one which separates the particles, water and oil, by centrifugal action, which catches and removes them from the main current, providing well defined courses for this purpose, using the water of condensation, which is hot, to wash the oil particles out, making a self-cleaning apparatus. The separator should be well covered to perform the best service.

These reasons are sufficient to make the use of efficient oil separators essential: Radiators and coils will perform their maximum service; the water is purified and saved so that the heat stored in this water is saved; repairs caused by blistered plates and bent tubes in boilers are avoided; losses due to unnecessary shut downs are eliminated.

The well informed engineer knows the useful purpose of an efficient oil separator. The poorly posted engineer or owner of a plant may have a more or less hazy idea that it is some sort of contrivance made for the purpose of catching and saving the oil from his exhaust and he regards the manufacturer who offers it somewhat in the nature of a gold brick solicitor.

An efficient oil separator, and we wish to emphasize the efficient, is a joy forever to the power plant owner, because of the saving of water, coal, repairs and accidents possible through its installation.

The oil separator makes itself an important factor of the feed water question. Exhaust steam at atmospheric pressure is equal to boiling water at 212 deg. F. Therefore, to save its heat, which is to save the coal necessary to produce it, makes for boiler room economy. But to use the water without removing from it the oil which passes from the engine into the exhaust steam would be poor economy for several reasons.

If this oil is fed to the boiler, it accumulates on the crown sheets or in the water tubes and prevents the water from coming in contact with them. This results in loss of heat units transmitted by the coal, in overheated plates or tubes which blister and bend under the effects of heat, causing leaks, if they do not burst under pressure.

If the steam is used for heating, the oil accumulates on the inside of the pipes, radiators or in condenser coils or in coils used in evaporating or boiling processes and prevents the radiation of the heat through the metal. The efficiency of radiators, coils, etc., is reduced enormously by this coating of oil, causing a great loss of heating efficiency.

When installing storage batteries, they must be thoroughly insulated from the floor and there are several methods that may be employed for this purpose. Two tiers of porcelain insulators may be used, the first tier being mounted on brick piers capped with hard pressed tile, and the first tier of insulators, which should be of the triple-petticoat pattern, placed on top of this tile. On top of these insulators 2 sticks are placed, and preferably covered with acid-proof paint; above these sticks are placed 3 tiles and on top of these tiles a second row of porcelain insulators which support the battery tank. In this case the bottom of the tank will be some 21 in. above the floor.

The floor should be made of glazed tile or vitrified brick with joists of asphalt, as the cement is attacked by the sulphuric acid which may leak over from the cells.

QUESTIONS AND ANSWERS

Our readers are invited to send in their troubles and problems; also to answer questions which are asked. All letters must have name and address of writer, which will not, however, be published. If answers are wanted by mail, send stamp for reply.

Engineer Head of Operating Force

I note the letter by W. G. B. on page 147 of the February issue of the Practical Engineer, in which he asks readers to render an opinion as to what portion of the station the switchboard operator is responsible and what portion the engineer is responsible. In reply to this I would say that in properly managed plants the engineer is responsible for the entire station, the switchboard operator being merely an assistant of the engineer.

The engineer has charge of the prime movers, consequently is the head of the operative force, and the switchboard operator's duty lies in maintaining the proper voltage, cutting in and out the different units at the switchboard, division of the load on the units in operation at various times and keeping the station records; hence, his duties are confined to and he is responsible for the operation of only the switchboard. Thus he constitutes only a part of the operative force and comes under the supervision of the engineer.

J. C. Kahl.

Stroke of Duplex Pump Affects Steam Consumption

Will you kindly inform me whether reducing the slack motion between the valve stem nuts of the high-pressure valves of a Worthington duplex compound pump increases or decreases the steam consumption, or can I shorten up the length of the stroke by so doing? N. K.

A.—Reducing the slack motion between the valve stem nuts of a duplex compound pump will shorten the stroke, and since this will increase the clearance of the pump, it will, of course, increase the steam consumption per horsepower-hour. It is always advisable to run a pump at as long a stroke as it will stand and not make trouble.

Pump Valve Trouble

In our pump room are 2 Blake duplex boiler feed pumps, 10 by 7 by 12 in., which run perfectly when running slow but act queer when running fast. When one piston is making the stroke from the water to the steam end it is all right, but when it makes the other stroke the valve opens about half way and then jumps wide open so hard that it hits on casting of the steam chest, causing a loud hammer. All the valves act the same way. These are supposed to be balanced valves and the nuts for adjusting lost motion are on the outside. There is plenty of room for the valve to open but it jumps so far that it strikes the steam chest. I would be glad to have the ideas of readers on this difficulty. W. W. W.

Peculiar Diagram Feature

I see in the February issue of the Practical Engineer, page 132, that Mr. E. E. Barclay shows 2 sets of indicator diagrams taken from his Bates Corliss engine, 16-in. cylinder, 36-in. stroke, running at 90 r. p. m. But he does not give the steam pressure nor the

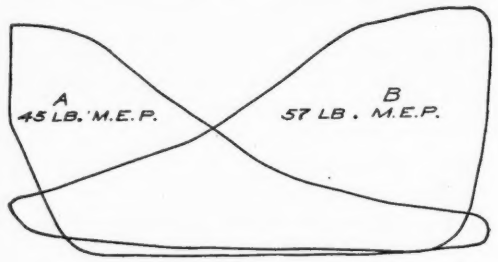


FIG. 1. LINOLITE DESK LAMP

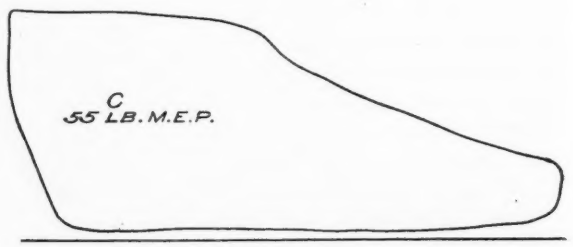


FIG. 2. DIAGRAM AT HEAVY LOAD

scale of spring that the diagrams were taken with. Supposing that they were taken with a 60-lb. spring, I have gone over them with a planimeter and found the m. e. p. to be as follows: A 40 lb., B 57 lb., and that of C 55 lb. I find, therefore, a difference of 37.08 hp. developed between A and B diagrams. Im my opinion this is too much, so I believe it would be a good plan to equalize the cutoff so as to make both ends as nearly alike as possible. The expansion line looks as if steam leaked into the cylinder after cutoff occurred. Mr. Barclay should even up the cutoff and send in another set of diagrams to Practical Engineer.

L. A. Cole.

Diagram Defects

In regard to E. E. Barclay's indicator cards in the February number, page 133, upon which he desires criticism, I would say the cards show a number of defects. The right hand card shows too little lead, a

wire drawn steam line, too late release and consequent high back pressure.

As for this right hand side I would advance the eccentric, which will make everything earlier, giving a more decided cutoff and horizontal steam line and a more nearly square corner on the steam line. It will also cause higher compression, which can be remedied by adjusting the exhaust rods to suit the case.

The left hand card shows excessive compression and it is evident that the indicator string was too long, which allowed the drum to come against the stop just before the engine got to the center, causing the straight line which shows from the compression up to boiler pressure. The release on this card is good.

The proper thing to do is to make sure the reducing mechanism is correct, because many an engineer has been mislead by not attending to this. Advancing the eccentric, as advised before, will increase the compression, which can be corrected by changing the exhaust rods. The end of the cylinder represented by the left hand card is apparently doing about 2/3 the work of the other end, which can be equalized by the governor rods in lengthening the cutoff.

The flatness of the expansion line indicates that the steam valves leak after the dashpot is down, keeping up the pressure after cutoff. It would be well to let both dashpots drop, closing both valves, then open the indicator cocks and centralize the wristplate and if the exhaust valves are set with a little lap or at least line and line, leakage by the steam valves will come from the indicator pipes. A. C. Waldron.

Water Level. Receiver Pressure. Heating Surface

S. H. W.—1. Is it possible for a boiler to be 0.75 full of water and show only 0.5 full by the glass, all connections being clear and open?

2. Suppose that a compound engine is built to run condensing and had to run noncondensing with all the valves operated by eccentric, and carrying a good load. The limit on boiler pressure is 130 gauge with 25 lb. receiver pressure. The steam is expanded down below atmospheric pressure in the high-pressure cylinder. What would be the remedy?

3. What amount of heating surface ought to be allowed per horsepower for a plain slide valve engine?

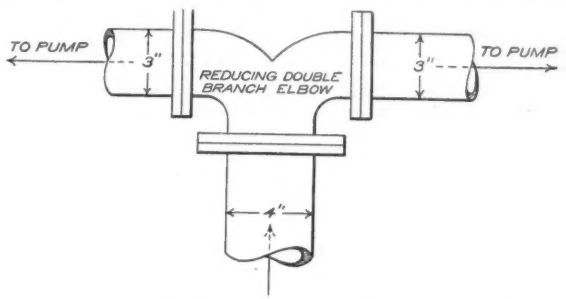
A.—Unless there is some heavy suction near the water connection of the glass which pulls down the level, it would not be possible to have a boiler 0.75 full of water and have the glass show only 0.5 full. I am rather puzzled, however, to know what kind of a gauge glass you have which will show when the boiler is only half full of water.

2. The way to overcome your difficulty is to lower the boiler pressure and change the setting of the low-pressure valve rods so as to lengthen the low-pressure cutoff. Lowering the boiler pressure will mean the lengthening of the high-pressure cutoff, and the low-pressure cutoff must be correspondingly lengthened to take care of the increased volume of steam handled.

3. The evaporation per square foot of heating surface in a boiler is about 3 lb. A D-valve engine will take 60 lb. of steam per horsepower per hour. This would call for 20 sq. ft. of heating surface per engine horsepower.

Double Pump Supplies

I wish to express an opinion upon the question and answer relative to "Pump Connections" by F. K., page 146, in the February issue of the paper. I do not think such an arrangement will do as well as may be expected, even if the pumps are run at a moderate or



DOUBLE PUMP SUCTION PIPE

slow speed. One pump will form a little better vacuum than the other, and I think the water will flow to that which reduces the pressure to the lower degree, so that one pump will probably get all the water it requires while the other may not get any at all; or if it does, it will get it only occasionally in "slugs." It may be possible so to regulate the speed of each pump separately that each would get its quota of water, but unless there were some one in constant attendance to meet any slight change in conditions the weaker pump, so to speak, would be spasmodically losing its water.

Some time ago I had 2 condenser circulating pumps which were connected to one suction pipe, relatively the same as illustrated in F. K.'s question, and we had trouble with the outfit from the very beginning. We would get them both started and apparently working satisfactorily when suddenly one of the pumps would lose its water. We tried to put both pumps in as good condition and as nearly alike as possible, and tried to find a speed most suitable for each one to make up for any discrepancy. But it was all in vain, in that particular instance, until the idea was suggested that an equalizing pipe with a controlling valve placed in it, be connected betwen the 2 condensers to which these pumps were respectively attached. The pipe and valve were put in and the scheme worked nicely although it required a little experimenting as to how much the valve in the equalizing pipe should be opened to maintain a balance.

Perhaps such a scheme may be applicable to F. K.'s outfit, and it would not cost so much as to prohibit experimenting with it. I think a ½-in. pipe and valve

connected between the suction chambers of the 2 pumps would be large enough for the purpose. I would also suggest that instead of having the tee to cap the 4-in. upright suction pipe, a reducing branch elbow be installed as appears in the illustration, this making an inducement for the water to split and flow to each pump with as little restriction as possible.

It would be of interest to most all the readers of Practical Engineer to hear from F. K. as to what he has done in relation to the matter, and with what result. Charles J. Mason.

Trouble With Alternator

We have in our light station a simple single-phase alternator of the old Westinghouse type. During the last few weeks this machine has been failing to keep up its voltage. The engine and the machine and its exciter run at their usual speeds. I have examined closely but can find nothing to cause the voltage to drop. Will you please tell me what probably is the cause of this trouble? The circumstances and load are the same as they have been for 3 or 4 yr. All of the resistance in the exciter and field of alternation is cut out. I noticed last night some of the field coils in the alternators seemed to be warmer than others.

J. S. J.

A.—The probable trouble with your machine is that part of the windings on the field coils have become short circuited. This would be indicated by the overheating of some of the coils and also by the fact that the voltage will not stay up. In an alternating-current generator the electromotive force generated under the different pole pieces is added together so that if the strength of one pair of poles goes down it lowers the voltage of the whole machine. If you put on the exciting current with the machine standing still and try the strength of the different pole pieces, it is possible that you will find 1 or 2 which are weak, indicating a short circuited coil. If you do not, it would be necessary to measure the drop in voltage over each field coil, and if you find one where the drop is small, that will indicate that part of the coil is short circuited. The remedy is, of course, to take off the coil, unwrap the windings until you find the short circuit, and repair the insulation.

Electrical Problems

1. I have a 110-volt, 20-kw. direct-current generator and wish to know how to calculate the number of 16 candlepower 3.5 watt lamps it will carry.

2. What is meant by ampere-hours?

3. I have a direct-current generator supplying current at 110 volts and wish to lower the voltage to about 10 in order that I may use it on a bell circuit and would like to know what I can use for resistance in order to get the desired voltage. How many 16 candlepower lamps would be required to secure this result and how should they be connected up?

4. How do you calculate the efficiency of a shunt-wound generator and also that of a shunt-wound motor? J. S. S.

A. 1. Your 110-volt, 20 kw. generator will carry as many 16 candlepower lamps as 56 is contained in 20,000, which is about 357.

2. The ampere is the rate of current flow and to get a definite measurement of energy, we have to know the time during which the current has been flowing. The ampere-hour is the amount of energy for any given voltage which is produced by an ampere flowing for 1 hr.

3. The amount of resistance needed to cut down the voltage from 110 to 10 volts on your bell circuit depends, of course, upon the current flowing. The resistance of a lamp is not a definite thing, particularly when the lamp is dark. The resistance gets less as the lamp heats up, but the cold resistance may be taken as somewhere around 500 ohms for a 110-volt lamp. Assuming that you need 0.1 ampere in your bell circuit, the resistance would be found by dividing the drop through your resistance, or 100 volts, by the current, 0.1, or the resistance would be 1000 ohms, which would mean 2 16-candlepower lamps in series.

4. To get the efficiency of a shunt-wound generator, multiply the resistance of a field winding by the square of the field current, multiply the risistance of the armature by the square of the total current, the sum of these 2 products will give the electrical losses. A certain amount of loss must then be added for friction in the bearings and against the air. This may be taken at from 2 to 3 per cent. Multiply the voltage of the machine by the current in the line and the result will be the output in watts. The input will equal the output plus the electrical losses plus the friction losses and the efficiency equals the output divided by the input.

The efficiency of a motor is usually obtained by the use of a dynamometer or prony brake. When a prony brake is attached to the pulley of the motor the output is equal to the pull upon the scales in pounds multiplied by twice the length of the arm from the center of the shaft in feet, multiplied by 3.1416, times the number of revolutions of the motor a minute divided by 33,000, which gives the horsepower developed. The input is the current in amperes multiplied by the voltage at the terminals, the product being in watts, which divided by 746 reduces it to horsepower. The output, found above, divided by the input will give the efficiency of the motor.

Boiler Doors; Scale in Pipes; Grate Area

1. Why cannot boilers be provided with rear doors as well as doors at the front for cleaning the tubes? When blowing out tubes from the front a great deal of the soot comes back into the tubes, while if they were blown from the back or rear end of the boiler the soot would be carried up the chimney as soon as it leaves the tubes.

2. How can feed pipes be cleaned without injuring the pipe?

3. What amount of grate surface is allowed per horsepower of boiler?

A.—No difficulty would be experienced in placing doors in the rear wall of the setting; the reasons why they are not put there are that the advantage to be gained by their use is too small to warrant the expense. The rear doors would have to be heavily lined with a good nonconductor of very durable material, which, in all probability, would be firebrick. This would render the doors very heavy and unwieldy, and if not provided with extra heavy hinges, and fastenings, and thorough protection from the heat, they would soon fail to close tightly enough to prevent serious leakage of cold air. This would not only tend to lessen the draft, but might result in injury to the boiler, especially the tube ends. It is true that some soot returns to the tubes while cleaning them, but if the damper is partly closed during the operation of cleaning, and then opened wide as soon as the cleaner is removed, the small quantity of soot which may have been drawn into the tubes will be carried through into the smoke-box by the stronger draft. The loss, if any, occasioned by the small amount of soot returning to the tubes is not appreciable in the operation of a plant.

2. By taking down the piping, heating the pipes quite hot and rapping them with a wooden mallet. By the term quite hot is not meant red hot nor a temperature anywhere near that corresponding to redness. Another method consists of boring out the pipes with a hand-operated bar of any shape most convenient to make. A bar bent at right angles, with the tip rounded to conform to the curvature of the interior of the pipe, will serve the purpose. A smaller pipe with the end flared bell-shape and beveled like a chisel edge on the inside, has also proved efficient. These methods are quicker and consequently cheaper than attempting to soften the scale by means of compounds.

3. It depends upon the kind of fuel and the weight that can be burned per hour, which, in turn depends largely upon the draft. With a draft pressure corresponding to ¼ in. water column 15 lb. of bituminous coal can be burned on each square foot an hour, and about 10 lb. of anthracite. If the boiler requires, say, 300 lb. of bituminous coal an hour, the grate surface will contain 300÷15=20 sq. ft. This figures out about 0.3 sq. ft. a horsepower for bituminous and 0.4 sq. ft. for anthracite coal.

Capacity of Scotch and Marine Type Boilers

Q. What is the formula for finding the approximate horsepower of Scotch and Marine fire-bottom boilers, which does not necessitate the figuring out of the entire heating surface. T. L. T.

A.—Under ordinary conditions with these boilers, from 0.6 to 0.75 sq. ft. of grate surface will develop 1 hp.

Leak Through Corliss Valve

1. How can you tell whether the valves on a Corliss engine are leaking, without an indicator?

2. Why is it that an ell is always placed on a boiler before connecting to the header?

3. What is the cause of the pounding in a B. & W. boiler at times when the boiler is being blown down and how do you remedy it?

4. Why is it that a duplex pump will not hit the heads when it loses its suction? W. C. H.

A.—In order to test the tightness of valves in a Corliss engine without using an indicator it is necessary to have the engine at your disposal to be able to see the outlet from the exhaust pipe. It is better, of course, if convenient, to break the connection of the exhaust pipe near the cylinder, but if this is cumbersome the outlet can be watched.

Disconnect the valve gear, turn the engine so that the exhaust valve is open, with the steam valves unhooked and, therefore, closed. Turn steam on the engine by the main throttle and watch the exhaust outlet. If steam comes through into the exhaust, evidently the steam valve is leaking. This test must be made separately for each end of the cylinder, of course.

Now, to test the tightness of the exhaust valve, with the valve gear still disconnected, set the valve gear, if possible, so that both exhaust valves are closed. It may be necessary in order to do this to disconnect the exhaust valves from the wristplate. Then turn steam on both ends of the cylinder by lifting the steam valves, and if the exhaust valves are tight no steam will blow through into the exhaust.

If this cannot be done, it will be necessary to turn the engine so that one exhaust valve is closed, and block it in that position, then turn steam on that end of the cylinder and note as to the tightness of that exhaust valve. Turn the engine over so that the other exhaust valve is closed and repeat the test.

2. The use of an ell in the front of a main header on a boiler connection is to allow some elasticity to take care of the expansion of the piping.

3. There is not always pounding in a B. & W. boiler when being blown down. I think your difficulty must come from some local cause due to the setting of your boiler or the arrangement of piping. Pounding is always due to water hammer and I should suspect that your trouble was due to a water pocket somewhere in the blowoff pipe.

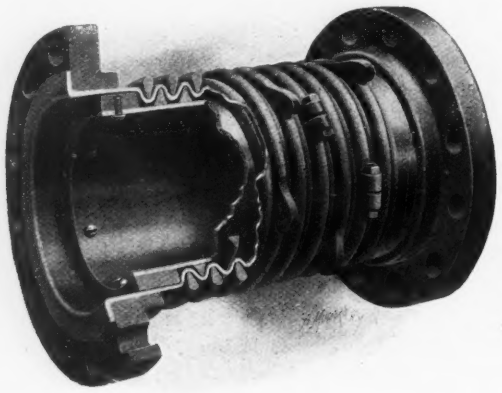
4. The steam valve in a duplex pump is reversed by the motion of the opposite piston, hence if the valves are set to give a proper length of stroke the reversal of a piston does not depend upon the pressure or suction in the pump but upon the setting of the valve and its proper action. It makes no difference whether the suction is off or on, the pump will work properly.

THE CALORY is the quantity of heat required to raise 1 liter of water 1 deg. centigrade.

WAINWRIGHT EXPANSION JOINTS

As temperatures in steam piping rise with the use of high-pressure and superheat it becomes increasingly necessary to allow for expansion in the pipe line and frequently it is inconvenient or undesirable to use long return bends.

For such places the Alberger Condenser Co., of New York, has an expansion joint which has many features to commend it. It is compact, being no more than the diameter of the pipe connected; it is free from



WAINWRIGHT EXPANSION JOINT

leakage and made so that it can easily be covered with non-conducting material; is easily installed and will resist high pressure.

When intended for steam lines, it is of the form shown in the illustration and has a main corrugated tube of soft copper with an inner cylindrical slip tube of hard copper or composition and with external and internal equalizing rings of cast iron which limit the movement of the corrugated tube in any one corrugation so that each part of the expansion tube will take its share of the movement. The external rings serve also to increase the strength of the joints. These joints are made to fit pipe in sizes from 2 in. up to 18 in. and specifications for larger diameters will be made when desired.

To control the movement of piping, guides and anchors are also provided by the Alberger Condenser Co., all of them being strong and durable; the guides serving to keep the pipes in alignment and permit lengthwise movement of the pipe, while keeping it in proper position, while the anchors are intended to limit the lengthwise movement to the position where it ought to take place and throw this movement upon the expansion joint.

"THE BEST WAY TO GET ABILITY is to do thoroughly whatever you have to do. It is much better and vastly more profitable to know how to do a few things well than to do a great many things indifferently."

IT IS STATED that a bushel of Indian corn will produce 27 gal. of alcohol.

IMPELLER PUMP INSTALLED FOR CONDENSING SERVICE

The development of impeller pumps was made primarily for pumping water for irrigation purposes from deep wells, because of the simplicity of the parts in the well and the ability of this type of pump to handle all the water such a well will produce. The field of application has widened considerably since these pumps came into use until now there are installations in many classes of service.

Shown herewith is a view of one of the 10-in. Columbus impeller pumps installed by Kingan & Co., one of the largest pork packers in this country, in

FIG. 1. IMPELLERS OF THE ROTH PUMP
FIG. 2. ROTH IMPELLER PUMP DRIVEN BY WESTINGHOUSE INDUCTION MOTOR

their plant at Indianapolis, Ind. There are 3 pumps, all alike; 2 pump water from deep wells into the reservoir, from which it is used for condensing purposes for a Westinghouse steam turbine of 500 kw. capacity; the third is installed to raise the water from the well to a higher storage reservoir, from which it flows by gravity throughout the plant. In each case the pump is equipped with a vertical Westinghouse induction motor of 75 hp. capacity and takes power from the 2-phase alternating current system at 440 volts, supplied for the entire plant from the turbo generator set and from several engine driven generators.

The principle on which the pump works suggests that of the centrifugal pump, but the impellers, as they are called, are placed horizontally within the casing, as shown in Fig. 1, and are spaced about 4 ft. apart along the shaft to which the motor is direct connected. The number of impellers depends upon the

depth of the well. The lower 2 or 3 must be submerged at all times; that is, they must be below the lowest water level in the well. The water is whirled upward by the first impeller to a stationary vane located just beneath the second impeller. This vane, or retarder, as it is called, stops the whirling motion of the water just before it enters the next impeller, but does not impede the upward progress. The second impeller then repeats the performance of the first, and so on, till the water is discharged at the top.

The only wearing parts in the pump are the guide and thrust bearings, both of which are located at the top of the well, where they may readily be inspected and repaired when necessary. The thrust bearing is specially constructed with rollers, so that the friction is reduced, as it is rolling and not sliding friction. The vertical motor is thus not called upon to carry any weight but its own, but is coupled to the pump by a flexible coupling.

In a test recently made on the pump installed for pumping into the reservoir at the Kingan plant, the pump handled 1121 gal. of water a minute, with an average power consumption of 43.2 kw., which means that the motor was running with an output of approximately 50 hp., or at 2/3 load.

The pump is manufactured by the Roth Manufacturing Co. of Columbus, Ind.

THE HAYS GAS ANALYSIS INSTRUMENT

The only means of determining the proper regulation of the air supply to a furnace is an analysis of the furnace gases. By this means the surplus air due to improper draft, air leaks in the walls, holes in the coal bed, etc., are indicated in the percentages of CO_2 (carbon dioxide). Furnace gas analysis also indicates the quality of the coal burned. In a word, through gas analysis the power producer is enabled to trace waste of fuel to the draft, the method of firing or the coal itself.

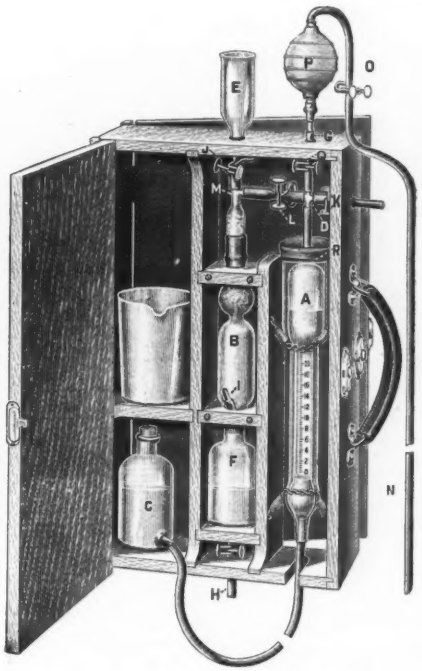
The Hays gas analysis instrument is a simple device designed primarily for the determination of carbon dioxide, oxygen and carbon monoxide in furnace gases. It can determine any other gas absorbable in any known chemical and can be put to a large number of uses outside the boiler room.

Being designed to meet the needs of boiler room practice, the instrument is small and compact, can be hung on a nail, and is adapted for reading in dark corners. All the fragile parts are spring suspended, thus insuring against breakage and it does not require a chemist nor an expert to operate it.

In brief, the operation is as follows: A sample of gas is drawn into the burette A, and accurately measured. It is then passed from A into the absorption vessel B, which contains a solution of caustic potash. Here the CO_2 is absorbed. The gas is then returned to the measuring burette and remeasured, the shrinkage being read off on the scale of the burette in direct terms of per cent of the gas absorbed.

In ordinary furnace practice the determination of CO_2 is all that is required. If it is desired to determine oxygen, the gas is then returned to the absorption vessel, this time containing a solution of pyropotassium. After this solution has absorbed the oxygen, the gas is returned to the burette again and measured for the oxygen contraction.

In like manner the sample is treated for any other



HAYES GAS ANALYSIS INSTRUMENTS

gases it is desired to determine, separate absorbent solutions being used in each case.

The Hays gas analysis instrument is manufactured by the Wm. B. Pierce Co., Buffalo, N. Y.

CLEANING OUT STIRLING BOILERS

No engineer cares to climb in through the manhole of any boiler that has just been withdrawn from service, more or less cooled off and blown out, except for the grim necessity of earning his livelihood. There are lots of other jobs that he would rather do and his chief thought is often to get through with the cleaning as soon as possible.

In the case of the Stirling boiler the operator cannot see through the tubes because of their curvature. For that matter he cannot be sure that the tubes are clean even in boilers which he can see through. He has to depend upon the sound, and if he works inside the drum, he must have an assistant outside the boiler to turn the water off and on as each tube is finished.

We illustrate herewith a new device with which a man may sit in a comfortable position on a platform or scaffold outside the boiler and with little physical effort feed the turbine into one tube after another. Instead of supporting a heavy weight of hose and

cleaner he can make the hose respond to his will by merely turning the crank. After a tube is finished the operator draws the turbine into the funnel and by a new setting of the feeding device he centers the funnel over the next tube to be cleaned and proceeds as before. The adjustment requires only a moment and the

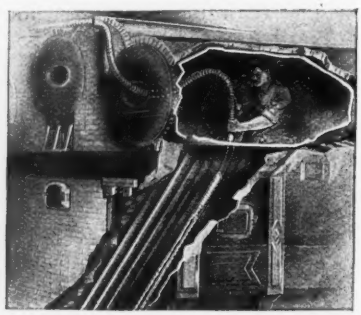


FIG. 1. THE OLD WAY OF CLEANING

water need not be turned off until all the tubes are cleaned, thus effecting a great saving of time.

The mechanism of this Lagonda feeding device, as it is called, consists of a funnel through which the cleaner is guided into the tube, a stand and shafting to support this funnel and hose, and to provide adjustment over the different tubes. The shafting is jointed and snapped together with triggers, so that the sections can easily be handled and used in the limited

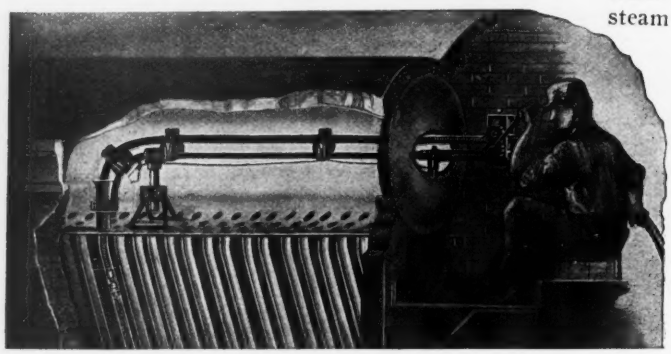


FIG. 2. THE NEW LAGONDA METHOD OF FEEDING

space between boilers. On each section of shaft is a spool and rack on which the hose is rolled. The shafting is held in the center of the manhole by a tripod rigidly braced from the edge of the manhole. Extending from this tripod is the feeding device proper for feeding the hose into the tube.

This feeding device consists of 2 capstan-shaped rolls, which enclose and grip the hose and which are geared together, so that when one is turned by the crank, the other turns. There is provision for squeezing these upon the hose as tightly as may be desired and the capstan rolls are lagged with leather, which grips the hose.

The hose can be plied back and forth by the movement of the handle as rapidly as and more accurately than by hand. The effectiveness of the control secured by this device can well be understood from the fact that a hose filled with water under high pressure is almost as stiff and rigid as a wooden pole.

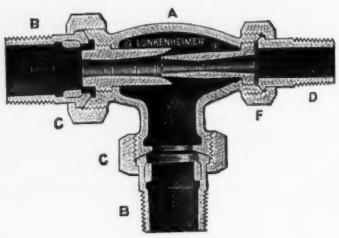
The Lagonda feeding device has been tested out by several years' service in connection with Weinland turbine cleaners and found thoroughly efficient. It may be used with any make of turbine, and is now being manufactured for sale by the Lagonda Manufacturing Co., of Springfield, O., which will send descriptive literature upon request.

AN IMPROVED EJECTOR

The Lunkenheimer Co., of Cincinnati, O., manufacture the ejector shown herewith, which they claim cannot be surpassed or even equaled for raising water from deep wells, mines, or pits, filling or emptying tanks, raising and transferring liquids (either hot or cold).

The superiority of this ejector lies in the construction of the tubes, which are made of a very hard grade of bronze especially adapted for the severe service to which ejectors are generally subjected. These tubes are screwed in the body, and held tightly by unions, consequently, there is no possibility of losing the tubes of this improved ejector, when the unions are removed.

Those parts subjected to wear consist of the tubes only, and these can readily be renewed at small cost when necessary. It is only necessary to turn the steam on full to operate the ejector, and after getting



LUNKENHEIMER IMPROVED EJECTOR

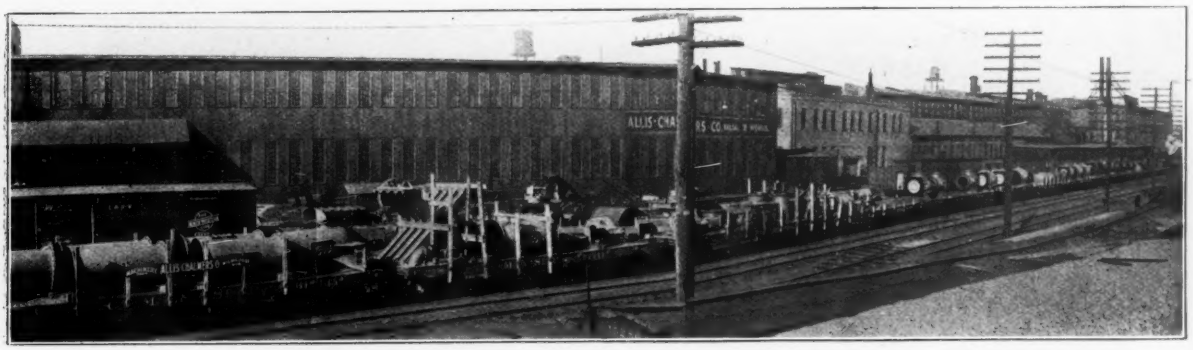
the flow of water established, the steam can be throttled to a very low degree.

According to the claim of the manufacturer this ejector will lift water at 75 deg. F. 3 ft. with a steam pressure of 5 lb., 15.5 ft. with 20 lb., 21 ft. with 25 to 30 lb., 19 ft. with 50 lb., 16.5 ft. with 80 lb. and 14.5 ft. with 100 lb. pressure; and with a lift of 5 ft. and water at 75 deg. F. the ejector will force the water 18 ft. with 20 lb. steam pressure, 36 ft. with 40 lb., 57 ft. with 60 lb., 74 ft. with 80 lb. and 92 ft. with 100 lb. steam pressure.

Standard sizes of these ejectors range in capacities from 250 to 11,000 gal. an hour, based on a lift of 20 ft. steam pressure at 50 lb. and water at 75 deg. F.

LARGE SHIPMENT OF PUMPING ENGINE MACHINERY

In the accompanying illustration is shown a train of 14 car loads of pumping machinery recently shipped by Allis-Chalmers Co. from its Reliance Works, Milwaukee. These parts constitute the water ends, only of 2 huge vertical triple expansion pumps, one purchased by the City of Chicago for installation in its Lakeview pumping station and the other by the San Antonio



TRAIN LOADED WITH ALLIS-CHALMERS PUMPING MACHINERY

Water Co., San Antonio, Texas, as an addition to its present equipment. An unequalled record for economical and reliable operation is linked with the shipping of this machinery, and it leaves the works of its builders with an assurance which carries the guarantee of years of successful operation. The first vertical triple expansion pumping engine designed for water works service in any country was built by Allis-Chalmers Co. almost 25 yr. ago, having since been in continuous service at the North Avenue station in Milwaukee, and the world's record for economy is still held by a machine of this type built in the same works from which the above described shipment has just been made.

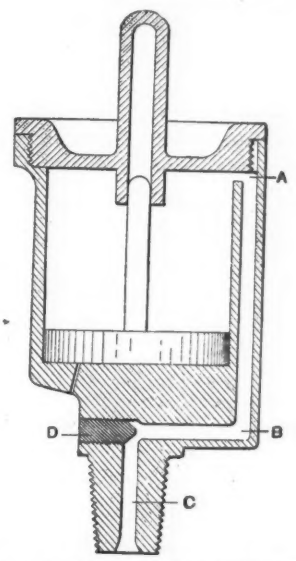
The pump for the City of Chicago will be of the vertical, triple expansion, condensing, crank and flywheel type, having 3 single acting pumps of the direct-flow type, equipped with automatic valves. The engine will be entirely self contained on the pump chambers. This unit is guaranteed to develop a duty of 155,000,000 ft. lb. of work delivered by the pumps for each 1,000,000 B. t. u. used by the engine and auxiliaries when pumping continuously at the rate of 25,000,000 gal. in 24 hr. against a total head of 140 ft. The San Antonio pump is practically a duplicate of the one just described. The normal and economical rating will be 20,000,000 gal. per 24 hr., but the manufacturers guarantee the unit to operate at the rate of 24,000,000 gal. per 24 hr. to meet special excessive demands for water as in case of fire, or extreme hot and dry weather, without unduly straining the engines or pumps.

IN TAKING UP LOST MOTION in eccentric or valve rod, it should be done in the direction in which the engine is to turn.

A NEW AUTOMATIC FORCE FEED OIL CUP

Lawson Mfg. Co., of Buffalo, N. Y., has recently patented a device for use on loose pulleys which has nothing to break or get out of order and distributes to the bearing of the loose pulley ordinary lubricating oil, giving perfect satisfaction. This has 3 distinct parts, a body, a piston or plunger, and an oil-tight cover, all parts being made of special Swiss brass highly polished.

As shown by the sectional view, the cup is screwed into the pulley and filled with oil; the cover is then screwed on, the piston being at the bottom of the chamber. The centrifugal force from the revolving of the pulley throws the piston outward, causing it to rise in the chamber, thus forcing oil around through the passage A B and out through C to the oil hole in



LAWSON AUTOMATIC FORCE FEED OIL CUP

the pulley. The rapidity of flow is controlled by the set screw D which varies the size of the opening into C and must be regulated according to the speed of the pulley.

When the pulley stops revolving, oil ceases to flow and when the pulley starts to revolve the flow com-

mences again. This cup needs filling but once a week, if the set screw is properly regulated. Ordinary lubricating oil such as is commonly used on shafting may be used with this cup, but a heavy body black oil is recommended by the makers of the device. The Lawson automatic force feed oil cup is made in 2 sizes, one for pulleys in diameters of from 6 to 12 in., the other with pulleys of diameters 13 in. or greater. The cup is guaranteed and if found defective will be replaced by the makers.

MANHOLE, HANDHOLE AND VALVE GASKETS

It is known to every engineer that the tightness of man and handholes on steam boilers, steam kettles

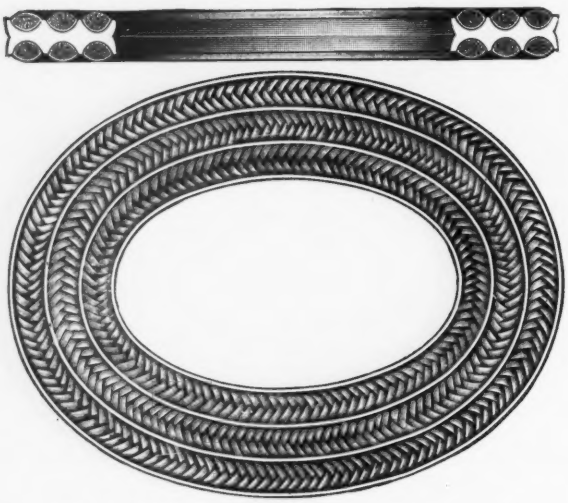


FIG. 1. THE GOETZE COPPER-ASBESTOS GASKET

and other steam apparatus is secured with great trouble, partly due to faulty construction of unions and uneven joint surfaces, but mostly from the use of packing material incapable of continually withstanding the high pressure used in modern steam boiler

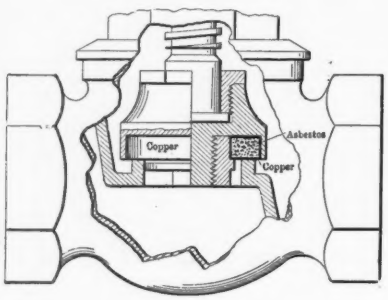


FIG. 2. ASBESTOS-INLAID COPPER VALVE DISK

plants. It therefore will be of interest to every practical engineer to know that F. Goetze has succeeded in constructing a gasket which will answer all demands with regard to absolute safety and unlimited durability.

The gasket is a combination of copper and asbestos-graphite as shown in Fig. 1. The plain profiled copper gasket itself would keep perfectly tight on even joint surfaces, but when inlaid with asbestos and graphite, the combined copper-asbestos gasket can be applied to the hardest joint with perfect safety.

Figure 2 shows a new copper valve disk with asbestos inlaid, something having all the elasticity needed

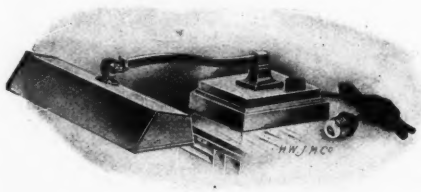


FIG. 1. LINOLITE DESK LAMP

for tight closing and with great durability under even the most unfavorable conditions.

Goetze's valve disk is a clever combination of copper and asbestos that resists high temperatures and extreme pressures and the seat of the valve does not become affected in any way on account of the elasticity. All sizes suitable for Jenkins valves and other valves of similar construction are kept in stock by the American Goetze-Gasket & Packing Co., of 529 E. 149th St., New York City.

A NEW IDEA IN DESK LAMPS

Proper illumination of desks is a problem which has never been satisfactorily solved. Most of the lamps used for this purpose today consist of an ordinary incandescent bulb lamp placed in a small reflector, which throws nearly all of the light on one section of the desk and leaves the balance of the desk insufficiently lighted.

The nearest thing to perfection is a new line of

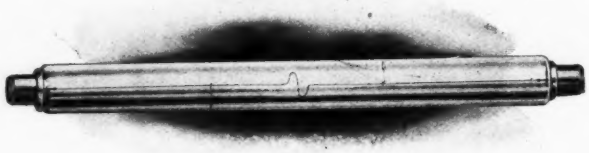


FIG. 2. TUBULAR LINOLITE LAMP

desk lamps recently placed on the market by the H. W. Johns-Manville Co., New York, known as "Linolite" Desk Lamps, several of which are shown by illustrations herewith.

While the design of these lamps is somewhat different from others now on the market, their novel feature is in the lamp. Instead of the bulb generally used, the tubular Linolite lamp, Fig. 3, is employed.

This tubular Linolite lamp is 12 in. long between centers and, therefore, distributes the light more

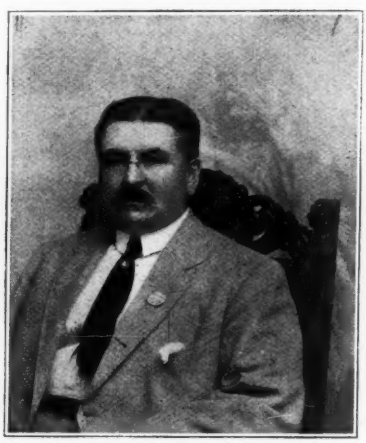
evenly and over a larger area of the desk than bulb lamps. Its filament is stretched out straight from end to end and lies throughout within the focus of the reflector. As the filament of a lamp throws its greatest light at right angles to its axis, this Linolite lamp

FIG. 3. LINOLITE TABLE LAMP

naturally gives more useful light than bulb lamps, whose filament cannot lie in the focus of a reflector on account of being coiled. These lamps are made in burnished old brass finish, oxidized copper finish and gun metal finish, and present a handsome appearance.

A NEW STEAM SPECIALTY COMPANY

George F. Hughson, the inventor and owner of the patents on the "Eclipse" steam specialties which have heretofore been manufactured by the John Davis Co., of Chicago, has formed a new company for the manufacture



GEORGE F. HUGHSON

and sale of the "Eclipse" devices and will continue to do business in the old factory at 860 South Halsted Street. The title of the new firm is the Hughson Steam Specialty Co., and the line of goods manufactured includes regulating, back pressure and relief valves, pump regulators, steam traps, separators and boiler blowoff valves.

DESIGN OF THE KNICKERBOCKER ICE CO. PLANT

Since completing the article on the Edgewater plant of the Knickerbocker Ice Co., it has been called to our attention that the design and installation of this plant were in charge of Postel & Linn, consulting engineers, of Chicago, who were called in by the Knickerbocker Ice Co. to design this plant on account of their previous good work on similar installations. The convenient arrangement, completeness of appointment and features tending to produce economy which are described in the article are sufficient evidence of the wisdom of the Ice Co. in engaging Messrs. Postel & Linn as engineers.

NEWS NOTES

THE DEATH OF EDWIN REYNOLDS was reported Feb. 19. Mr. Reynolds was formerly chief engineer of the Allis-Chalmers Co. of Milwaukee, and his engineering work for the past quarter century is well known to members of his profession.

NORTHERN WATER SOFTENER Co., Madison, Wis., has been doing extensive business during the month of February. Five equipments for the softening of water were sold before the middle of the month.

NELSON VALVE Co., which has extensive works located at Wyndmoor, Montgomery Co., Pa., just across the county line from Chestnut Hill, began business in 1893, manufacturing valves of all kinds under the Nelson patents. Its success has been so great that it now employs 250 men, most of them skilled mechanics, and is making plans to increase largely its manufacturing facilities. Heretofore it has been incorporated under the laws of New Jersey, but is now taking out a new charter under the laws of Pennsylvania, giving it the right to manufacture and sell pipe, valves, machinery, fittings and steam specialties. The new company will have authorized capital of $1,000,000 and will have as officers: President, Samuel F. Houston, of the Real Estate Trust Co.; vice-president, Carlisle Mason, who has heretofore been general manager and will retain that office; secretary-treasurer, Russell Bonnell.

One of the new products of the company is a valve designed especially for use with superheated steam, which will be chiefly of large diameter and is made of the finest grade of cast steel with nickel seats, these materials having been found the best for the high temperatures used when steam is superheated. In enlarging the plant at Wyndmoor the new buildings are of reinforced concrete, eliminating all danger from fire, which is necessary because of the costly machinery used in manufacturing the high grade of valves and fittings made by the Nelson Company.

ON JAN. 1 B. M. Knobel severed his connection with the Crandall Packing Co. and has organized the Triumph Engineering & Supply Co., with headquarters at 253 La Salle St., Chicago, where will be carried a stock of rubber goods, packings, etc.

ON TUESDAY, FEB. 9, Hoboken Association No. 5, N. A. S. E., held its seventh annual entertainment and reception at Oddfellows' Hall. A pleasing program of songs and specialties was rendered by a number of artists, assisting Bert Self, of the Keystone Grease Co., Henry Elder, of the Wilpaco Packing Co., Billy Murray, of Jenkins Brothers, and Jack Armour, of the Hill Publishing Co. Following this entertainment there was a

most enjoyable evening of dancing. The committee that had the successful evening in charge were: Wm. J. Reynolds, chairman; Jas. J. Durkin, Adolph Comens, John Platt, and Henry Downes.

W. S. HAGER, assistant to President Whiteside of the Allis-Chalmers Co., is taking a 3 months' rest in California and C. A. Tupper, manager of the department of publicity, is now acting as assistant to the president.

A DEVICE FOR CONVERTING THE ENERGY OF FUEL into power without the use of boilers has been invented by Geo. D. Benson of Niles, Mich. His plan is to reduce the fuel to a powder in which condition, accompanied by a blast of chemically treated air, it is forced into a white-hot magazine inclosed in a retort. The force of the explosion which follows is transmitted through controlling devices to the engine.

WIRELESS TELEGRAPHY by means of which a typewritten message is written without the aid of an operator at the receiving end is the latest marvel among wireless inventions.

THE ROCKWELL FURNACE CO. has been awarded the contract covering the complete furnace equipment for the new locomotive shops of the D. L. & W. R. R. at Scranton, Pa. The furnace equipment consists of 35 of the latest type furnaces operated with 300 B. t. u. water gas, which is made in Loomis Pettibone producers. These shops will be capable of turning out complete locomotives, and are to be in operation in 3 mo. No pains or expense has been spared to make them up to date, as they embody the latest and most improved machinery and equipment selected after thoroughly inspecting a large number of modern railway and industrial plants throughout the country.

CONTROL OF THE MOTION of a dirigible balloon from a wireless station has been achieved by Mark O. Anthony, an electrical engineer in New York City. Control was effected on a small apparatus at distances up to 200 ft., and the inventor claimed that he could control a balloon a distance of 12 or 15 miles with the apparatus shown.

PROFESSOR L. P. BRECKENRIDGE, head of the department of Mechanical Engineering, University of Illinois, has announced his intention of leaving that institution and will take a similar position with the Sheffield Scientific School of Yale University.

SUPPLEMENTING ITS ESTABLISHED TESTING DEPARTMENT, the Standard Roller Bearing Co. of Philadelphia has secured Henry Souther, of Hartford, Conn., as consulting engineer to devote a large part of his time to its interests. Mr. Souther's services have recently been employed to some extent by this company in this direction, and the above arrangement is the outcome of the satisfactory results obtained in the betterment of its product.

WILLIAM KENT, author of the Mechanical Engineer's Pocket Book, and for 5 yr. dean and professor of mechanical engineering in Syracuse University, has accepted a position as general manager of the Sandusky Foundry & Machine Co., Sandusky, Ohio, which manufactures triplex power and electric pumps, threading machines and other machine specialties.

THE LIBERTY MFG. CO., OF PITTSBURG, PA., has discontinued its arrangement with the Advance Packing & Supply Co. and made new arrangements with regard to the handling of its goods in Chicago by opening an office at 1201 Manhattan Building, which will be in charge of W. M. Burns and G. M. Porter.

CHARLES T. MAIN, mill engineer and architect of Boston, reports that the new buildings for the Warrenton Woolen Co., Warrenton, Conn., are completed, that the machinery is now being erected and that the engine has been started up.

F. W. DEAN, mill engineer and architect, Boston, Mass., is acting for the city of Baltimore, Md., in the matter of valuation of plant and property of the Warren Mfg. Co., Warren, Md., in which are concerned some interesting questions as to the value of an old water power with supplementary steam power as compared with that of a modern steam plant for the development of all power.

R. R. KEITH, for many years identified with the Sight Feed Oil Pump Co., of Milwaukee, has severed his connection with this concern and on Feb. 1 became identified with the A. O. Smith Co., of Milwaukee. In his new duties Mr. Keith will be assistant to the general superintendent of works. The company manufactures automobile frames and parts, selling its product to many of the prominent automobile manufacturing concerns of the country. It employs an average of 750 hands and has a completely appointed plant, and at the present time is operating both day and night to take care of the demand for the goods.

Mr. Keith's old friends will regret his leaving the engineering field, but wish him every success in his new undertaking.

ANNOUNCEMENT is made by the Standard Roller Bearing Co., of Philadelphia, of the further expansion of its sales organization by the appointment of F. M. Germane, formerly sales manager, as assistant general manager of the company; T. J. Heller as sales manager, and F. W. Lawrence as western representative, the latter with headquarters at Chicago.

THE BUSINESS HERETOFORE CARRIED ON by the American Engineering Specialty Co., with headquarters at Chicago and branches through the middle west, will hereafter be conducted in the name of Warren Webster & Co., whose main office and works are at Camden, N. J. The full line of Webster apparatus and specialties will be handled by the new organization.

D. D. PENDLETON, who was connected with the Westinghouse Electric & Manufacturing Co., of Pittsburg, Pa., for some 15 yrs., has recently opened an office as district sales manager of the American Boiler Economy Co., manufacturers of the Copes feed-water regulator, and the Copes pump governor, which so controls the inflow of feed water to steam boilers that the water level is held within narrow limits. Mr. Pendleton's offices are located in the Frick Building Annex, Pittsburg, Pa.

BOOKS AND CATALOGS

EVERY YEAR *Practical Engineer,* of London, issues 2 pocket books, one on electrical engineering, the other on steam engineering. These are revised each year, and contain a good selection of tables, rules and descriptions in regard to electrical wiring, instruments, tests and machinery. The book for 1909 on Electrical Engineering contains 512 pages, covering well the subjects treated, and taking up besides the electrical machinery proper the matter of bearings, belt and rope drives, gearing, the generating plant, the application of motors to tools and machines, rules for wiring, for the installation of dynamos and motors, and tables in regard to the wiring of circuits and of mathematical values.

DRAWING INSTRUMENTS, by Walther G. Stephan. New York, 1908. 110 pages illustrated, cloth, $1.

This is not a treatise on how to make drawings but is an important book to the draftsman. It tells, how to select good instruments, what instruments are needed, what each one is for and how to take care of it so that it will do good work and last. The book will help the novice in drafting to get started right.

THE PLANE TABLE, by W. H. Lovell. New York 1908, cloth, $1.

The plane table is an inexpensive form of surveying instrument for plotting the drawing of a piece of land as it is surveyed. This book explains its use and its advantages so that anyone familiar with the elements of geometry and the requirements of surveying can readily understand it.

HYDRO ELECTRIC DEVELOPMENTS, by Preston Player. New York, 1908, 68 pages, cloth, $1.

A general treatment of the subject dealing with the first cost, probable receipts, examination of site, running cost and probability of making profit. It is for those interested in the subject from an investment standpoint, but involves also a lot of engineering.

MODERN POWER GAS PRODUCERS, by Horace Allen. 5 by 7 in., 325 pages, illustrated, cloth binding, New York, 1908. Price $2.50.

This book is written largely from the standpoint of English practice, but is by a writer who has made a careful study of the principles of the subject and who gives the information that he has collected in clear and understandable fashion. It treats of fuels under the headings of natural and manufactured gas, coal, gasification of fuel; of producers under the headings of pressure type, recent improvements in pressure producers, suction type, requirements for successful operation of the suction type; and of the general subject of applications under the headings of general considerations, the use of gaseous fuel in internal combustion engines, properties of combustible gases, proportions of pipes, analysis and examination of gases and the testing of producers. It gives a clear idea of the condition of the producer gas field and of English practice, but contains nothing in regard to American practice.

BOILER ACCESSORIES, by Walter S. Leland. 6 by 9 in., 120 pages, cloth binding, Chicago, 1909. Price $1.

In this volume there is nothing in regard to the boiler itself, but all accessories of the boiler room are treated. Beginning with boiler setting, including the subject of grates and special furnaces, the matter of draft is taken up, the method of measurement, cleaning tubes, gages for steam and water, valves for the control of steam and water, and the safety valve, methods of blowing down, pumps and injectors, feed heaters, separators (though why these should be considered as boiler accessories is somewhat of a question), steam traps, calorimeters, piping, a brief treatment of the subject of corrosion and incrustation. All the topics treated are touched rather lightly, but sufficiently for the beginner in the field of steam engineering, and the book is clear and understandable throughout.

THE BOILER. By Stephen Christie. 6 by 9 in., 258 pages, illustrated, paper cover, Chicago, 1908. Price, $2.50.

Experience as boiler maker and as boiler inspector has given Mr. Christie good preparation for the work of writing a book on this subject. While he does not claim originality in the work, he has accomplished what he set out to do, of presenting the subject in a clear and satisfactory manner. Boiler materials, their properties and the methods of testing, the selection of a boiler and determination of what power of boiler will be needed for a plant, the figuring of heating surface, are preliminary subjects treated in the first 2 chapters. Boiler construction, showing the sizes and weights of parts, proportions of rivets and spacing for joints, allowances for irregular plates, etc., are treated in the third chapter, which also gives a number of tables and a good many shop notes in regard to actual construction operations. Braces and reinforcing takes up the subject of flue braces, crow-foot stays, dished heads, crown bars, reinforcement for manholes and handholes, and staybolts. Government rules are given in full, and the calculation of the strength and of the proportions for lap joints and for butt joints is shown at great length. The discussion on double riveted and triple riveted lap and butt joints is especially complete, and even the quadruple riveted joint is treated to some extent. Computation of the strength of the boiler, directions for setting boilers, proportions of chimneys and stacks are well taken care of. The book is conspicuous by devoting more space and attention to the modern spring loaded safety valve than it does to the old-fashioned ball and lever type, a welcome change from most elementary books on the subject. The arrangement of the engine room force and the routine of tests and inspection is given in the latter part of Chapter 9. Chapter 10 is given up to miscellaneous topics, including feedwater heating and purification, pumps and tanks, theoretical steam consumption of an engine, and tables of various values.

THE ECONOMY FACTOR IN STEAM POWER PLANTS. By George W. Hawkins. 6 by 9 in., 133 pages, in cloth binding, New York, 1908. Price $3.

In this book the object of the author has been to take up and discuss those points which need consideration in order to get the highest efficiency from a steam plant and to run with the lowest steam and coal consumption. The book is divided into 4 parts, the first having to do with individual apparatus, such as boilers and furnaces, engines, generators, condensing apparatus, pumps, feed heaters and economizers; the second part on the factor of evaporation, the third part on complete plant economy at full load, discussing noncondensing plants, condensing plants having surface or jet condensers, and pumping plants, and the fourth part is on complete plant economy when the load is variable. The study of economy is greatly facilitated by the use of numerous graphical diagrams showing the variation of steam consumption with load carried for different styles of engines, efficiencies of dynamos, and the expression of the different equations that are derived for the variation in economy of the steam plant. The book is a discussion suited for chief engineers who are well versed in algebra and the use of graphical diagrams and for them will be found of great value. It is not a book for the beginner nor for the man who is afraid to figure things out or afraid of equations having letter symbols instead of arithmetical rules.

LIQUID AND GASEOUS FUEL. By Vivian B. Lewes. 6 by 8 in., 334 pages, illustrated, cloth binding, New York, 1907. Price $2 net.

When one starts on the subject of combustion of fuels and boiler room practice it is with the expectation of finding dry reading and of having to force the mind to give attention to the work in hand. It is, therefore, a pleasant surprise to find the attention held easily by a writer on this subject, and to find descriptive parts of the book as interesting as a magazine article. Of course,

there are figures and tables, but the matter is treated entirely with arithmetical rules, and the part which takes up chemical reactions and processes is so clearly expressed that it can be readily understood by anyone at all faimliar with scientific terms. The first section of the book is devoted to fuels in their natural state, the processes of combustion and the formation of coal gas and oils. Following this are taken up methods of determining the heat value and the use of the different forms of calorimeter. Two chapters are then devoted to petroleum, its sources, properties and uses, 2 chapters to the subject of coal gas making, composition and values, 2 chapters to the subject of water gas, the plants used, the properties of the gas and different forms that have been developed in processes for its manufacture. The final chapter is devoted to the comparison of thermal values of solid, liquid and gaseous fuel, to the utilization of peat and to the possibilities of alcohol.

ELECTRIC MOTORS, by Norman G. Meade, New York, 1908, cloth bound, 159 pages, fully illustrated, price $1.

For those beginning the study of electrical machinery, this book will be found of great help. It takes up electric motors, motor generators, instruments, control and auxiliary apparatus, and gives hints on operating motors and on making repairs. The principles of operation of the machinery are explained and the connections explained.

Particularly good is the section devoted to control and auxiliary apparatus, which shows fully the connection drawings of starting boxes and controllers, and how they should be used.

FROM THE TECHNICAL PUBLICITY ASSOCIATION, of New York, comes the T. P. A. Bulletin, the new publication which has just been brought out in the interests of the association. The association is well known as an organization of managers of publicity among machinery manufacturers. It has high standing among advertisers and publications and the bulletin is a worthy representative of it.

STERLING LUBRICATORS are, as their name implies, of sterling value. Why, is told in the 1909 edition of the Sterling Lubricator's catalog, which has just come from press. This shows in detail the construction of the lubricator and illustrates the different styles which are made for all kinds of uses.

THE INDUSTRIAL INSTRUMENT CO., of Foxboro, Mass., has adopted an innovation for making known its instruments to the instrument-using world. This is a periodical called the Foxboro *Recorder*, of which the first number has just reached this office. It will be a paper in regard to the manufacture and use of instruments, the first issue being devoted to the construction of the Model A movement for indicating pressure gages. Another publication put out by a branch of this concern is a handsome catalogue on Self-Winding Clock Systems, which is published by the Standard Electric Time Co. This shows the advantages of the system and the different styles of clocks manufactured and explains fully their use for different purposes.

BULLETIN NO. 5370 of the Western Electric Co. deals with the subject of steam turbines and shows in detail the construction of the case, the guide blades and the running wheels. It may be had by writing to the company at Chicago, Ill., for the bulletin and giving its number.

A NEW CATALOGUE ENTITLED Pipe & Boiler Insulation has just been issued by the H. W. Johns-Manville Co. of New York.

This book is devoted to a thorough presentation of the problems of insulating all kinds of heated and cooled surfaces, such as pipes, boilers, furnaces, flues, ducts, etc., as well as insulation for refrigerating and cold storage work. The book is the most complete of its kind ever issued to the trade and bears out the company's idea "a covering for every condition." It is very handsomely illustrated and printed throughout. A copy of the catalogue can be secured by addressing the company's nearest branch and asking for Catalogue 100.

THOSE WHO HAVE THE BULLETINS of the Wheeler Condenser & Engineering Co., Carteret, N. J., will be pleased when they receive the convenient cloth binder which the company is sending out to contain those bulletins.

YORK MFG. CO. in its Bulletin No. 36 describes a horizontal double-acting ice machine and refrigerating machine of 40-ton capacity, in No. 37 a 65-ton machine, and in No. 38 gives a table showing the results of competitive tests made in Rochester, N. Y., between the York and De La Vergne equipments.

THE WHEELER-EDWARDS AIR PUMP is the subject of an elaborate 32 page treatise published by the Wheeler Condenser & Engineering Co., Carteret, N. J. The peculiar action of the Wheeler-Edwards pump in handling both air and water is explained and it is shown how the absence of foot and bucket valves, and an exceedingly small clearance results in the attainment of a high vacuum, otherwise to be had only by means of separate dry vacuum pumps, hot well pumps, and air coolers. Various types of Wheeler-Edwards pumps are shown, also a number of large steam turbine installations in which these pumps are used. The latter half of the book is made up of discussions of the principles of air pumps, tables of mixed vapors, a complete and original table of saturated water vapor from 80 to 180 deg. F., etc. The final section gives practical instructions for the handling of pumps of this character. This booklet should be valuable to anyone interested in vacuum machinery.

THOSE WHO HAVE NOT SEEN the handsome encyclopedias issued by the American School of Correspondence on Engineering and technical subjects will be pleased to learn of the offer which is being made of that valuable work. The encyclopedia of Mechanical Engineering covers shop work, boilers and engines, gas producers and mechanical drawing, 3 volumes being given to various shop operations in wood and iron, 1 volume to boilers, 1 to steam engines, 1 to gas producers and 1 to mechanical drawing and machine design. With the boilers are included accessories and steam pumps, and with engines the refrigeration plant. The usual price of these 5 volumes is $36, but a special offer is now being made by which the cost of examining the books is only the price of a stamp requesting the privilege, and the cost of the books themselves is only $18.60. Five days are allowed for examination. A handsome circular and mailing card are being sent out giving the details of this offer.

A BULLETIN OF SPECIAL INTEREST to purchasers of steam engines and to engineers called upon to select such engines, as well as to designers and manufacturers of such machines, has just been issued in the engineering series of the bulletin of the University of Wisconsin, under the title "Current Practice in Steam Engine Design." The monograph was prepared under the

direction of the late Storm Bull, professor of steam engineering, by O. N. Trooien.

The book, which is intended for general distribution, contains more than 40 charts showing graphically the proportions, weights, and dimensions of all the essential parts of Corliss and high speed automatic engines. It is the result of an investigation of considerable extent of steam engines of recent construction, and shows the many interesting changes that have taken place in the last 10 yr. Those interested in selecting steam engines will find it useful, as it enables comparisons to be made between plans and drawings submitted and the minimum, average, and maximum weights and proportions in current practice. The bulletin also contains formulæ for designing all the essential parts of a steam engine, and thus should aid in developing a more rational system of steam engine design.

THE AMERICAN ARTISAN, Chicago, Ill., is issuing a book on the subject of Retail Advertising particularly for hardware dealers, discussing the proper form of advertisements to be used in newspaper work. It is a book of 300 pages giving numerous examples of good and bad advertisements, pointing out the defects of the bad ones and the advantages of the good ones. Price $3.50.

MULTIPHASE ALTERNATORS of the engine driven type with revolving field as manufactured on the system by the Ft. Wayne Electric Works, Fort Wayne, Ind., are fully treated in bulletin No. 1109 of the Fort Wayne Electric Works.

I. B. WILLIAMS & SONS of Dover, N. H., are manufacturers of a full line of flat and round belting and of rawhide and tanned belt lacing leather. An attractive book showing how the leather for belts and for lacing is manufactured and giving rules for lacing the belt is issued by this firm and will be found of interest by those who receive it.

THE GENERAL ELECTRIC CO. HAS JUST issued a bulletin devoted to large transformers, in which are given some of the more important points regarding the relative merits of the different types of large transformers manufactured by this company. This publication has to do with the oil cooled, water cooled, and air blast transformers of large capacity, and contains illustrations of both the exterior and interior of various types. It contains also information intended to assist a customer in determining whether air blast or water cooled transformers will be more suitable for a given installation. The number of this bulletin is 4640.

SIGHT FEED OIL PUMP CO. OF MILWAUKEE has issued Bulletin No. 209, describing the Richardson Automatic Sight Feed Oil Pump, Model M, which is a simple device containing a combination of individual pumping units, operated by one mechanism and feeding oil in the desired quantities, to the different parts of an engine.

THE SIGHT FEED OIL PUMP CO. of Milwaukee is now getting out its bulletins in standard size, 6 by 9 in., which, for convenience, can be bound in covers and kept for future use. The January bulletin illustrates Model M pump, giving both sectional and exterior views.

The pump itself is fully described in an attractive way and prices are quoted on the various sizes which the company manufactures.

BULLETIN NO. 16 of the Industrial Instrument Co., Foxboro, Mass., is devoted to the subject of revolution counters of various types. It illustrates Standard revolution counters of the dial form, giving price list and capacity, also shows Standard counters of the square type tachometers for indicating the revolutions per minute, and tachographs for indicating and recording the speed. This last named instrument is particularly useful in showing the speed variation of machinery which it is desired to test and of keeping record of how much the speed variation is in mills where the shafting for machinery must be kept within a certain limit of speed variation.

Bulletin No. 13 of the same company, which is a pocket folder, shows clearly the details of the independent movement of the Standard gauge and the appearance of the gauge when completed.

A HANDSOME BOOKLET, about 5 by 8 in., has recently been gotten out by the Joseph Dixon Crucible Co., Jersey City, N. J. It is entitled Lubricating the Motor. The booklet opens with a brief treatment of flake graphite lubrication. A good point is developed concerning the peculiar advantage of flake graphite when combined with oil or grease, due to the lack of sensitiveness of flake graphite as compared with oil or grease. The booklet is divided into chapters which deal with the individual part of motor mechanism: cylinders, transmissions, bearings, etc.

GARVIN MACHINE CO., of New York City, is sending out Edition D of its catalog, which is printed in French, German and English, for use in export trade, and describes a line of special machine tools including milling machines, tapping machines, gang drills, etc. Other catalogs of the company are devoted to plain milling machines of all kinds, to screw machines and turret lathes, hand lathes and pulleys and shaft.

FROM THE INDUSTRIAL INSTRUMENT CO., at Foxboro, Mass., comes Bulletin 18, which covers low-pressure liquid and spring type gages. This includes the siphon or water gage for measuring chimney draft, open mercury gages for measuring low pressures or vacuum in condensers, and standard pressure testing set, and standard gages of the spring type of both indicating and recording models. These bulletins will be sent free to those interested upon application.

GREASE VS. OIL is the title of a comprehensive and instructive booklet sent out by the Keystone Lubricating Co., of Philadelphia, showing the advantages of grease for lubricating all kinds of bearings and giving in detail the methods of applying it. The results are given of comparative tests made at the works of Wm. Cramp & Sons, Philadelphia, showing the comparative merits of Keystone Grease and of oils for journal bearings.

POLYPHASE MOTORS as made by the Wagner Electric Mfg. Co. of St. Louis are described and illustrated in that Co.'s bulletin No. 82.

HANCOCK VALVES is the title which is embossed in red on the brown cover of an attractive and handsomely printed catalogue published by the Hancock Inspirator Co. of New York City.

OIL WELL SUPPLY CO., of Oswego, N. Y., has recently published 3 interesting catalogues in regard to the boilers which it makes. The first of these is on Water-Tube Boilers and shows in detail the construction and setting of the different types. The second is on Horizontal Tubular Boilers, Class "B" and gives general specifications for this type of boiler. The

third is on Locomotive Type, Portable Boilers, Class "D."

SHOP HEATING by F. R. Still is the title of a treatise containing practical suggestions on this subject, issued by the American Blower Co., of Detroit, Mich.

DETROIT STEAM TRAPS are of the tilting tank type and are made for return traps and for separating traps. As return traps they may, of course, be used for feeding boilers from any source on either the single or double trap system. The bulletin describing them is No. 247 issued by the American Blower Co.

CATALOGUE NO. 11 of the Alberger Condenser Co., 95 Liberty St., New York, describes in detail the Wainwright Expansion Joints. These are made of a corrugated tube of soft copper, an inner slip tube of hard copper and cast-iron rings fitting the corrugations on the inside and outside to limit the movement of the corrugated tube in any one groove so that all grooves will be active in taking up expansion. The catalogue gives tables of sizes and dimensions and shows applications of the expansion joint in different positions.

A NEW COMPANY for the manufacture of electrical instruments has been formed, with factory at Bethlehem, Pa., and main office in New York City. The firm name is the Roller-Smith Co., and it is a consolidation of the Whitney Electrical Instrument Co., which for many years had a factory located in Penacook, N. H., and the Switchboard Equipment Co., which has operated on circuit protective devices at Bethlehem, Pa. Machado & Roller, of New York, are general sales agents for instruments and circuit breakers manufactured by this company. An interesting and handsomely printed catalog describing the different kinds of apparatus has just been issued.

THE MURPHY FURNACE IN THE PAPER MILL is the title of an interesting and attractive booklet which comes to us from the Murphy Iron Works, of Detroit, Mich. It illustrates different mills in which Murphy furnaces are installed, and shows views in the boiler rooms indicating the arrangement of the boilers and stokers.

THE WATER QUESTION is one of great importance in the power plant. The Dodge Mfg. Co. is issuing a booklet with that title which describes a system for purifying and softening water for factory and boiler room purposes, the softening taking place before the water enters the boiler. It gives the details of the Dodge system of water softening, discusses the advantages of that system, and shows some of the plants in use.

THE UNDERFEED STOKER CO. of America has recently published 2 booklets on the Stoker in Marine Practice. One of these gives interesting data in regard to the steamship, James E. Davis, which is an ore and coal carrier used on the Great Lakes. The other is in regard to the hydraulic dredge, Francis B. Simmons, used by the Commissioners of Lincoln Park, Chicago. Both pamphlets contain not only interesting information about the installation of the stokers on the boat but also interesting data from the owners about what they have accomplished by the automatic stoking.

AN ATTRACTIVE COUNTRY ROAD bordered by well-kept orchards is the head piece of a catalog on How to Spray and What Sprayers to Use, published by the Goulds Mfg. Co., of Seneca Falls, N. Y. While the spray pumping outfit is designed primarily for use in orchard work, it is of advantage in other lines, such as whitewashing, disinfecting and cleansing. Spraying outfits are made for both hand and machine operation in a variety of styles, as shown in the catalog.

THE VERY LATEST CATALOG on feed-water regulators and boiler feed pump governors issued by the "S-C" Regulator Co., Fostoria, Ohio, is entitled The New Idea. This booklet tells all about a new system which can be readily applied to any boiler installation and which carries a guarantee to do the work for which it is designed.

THE SECOND NUMBER of *Industrial Progress*, published in Milwaukee, by the Industrial Progress Co., P. O. Box 1580, has interesting articles on the application of electric power to paper mills, Manhattan high-pressure fire service, modern steam condensing apparatus, the plant of the Kokomo, Marion & Western Traction Co., and some modern methods of ore treatment.

THE GARDNER COMMERCIAL GAS ENGINE is fully described in a handsome catalog issued by the Gardner Convertible Steam and Gas Engine Co., of Washington, Pa. The engine is made in sizes from 15 up to 60 hp.

TRADE NOTES

THE YORK MFG. CO., of York, Pa., has recently made the following sales:

Westerlin & Campbell Co., Chicago, Ill., 1, 2-ton, 2 4-ton and 1 10-ton refrigerating plants; Webster Citizens' Ice Co., Buffalo, N. Y., 100-ton ice making plant; Buscher Ice & Coal Co., Litchfield, Ill., 1 25-ton ice making plant; Desbrook & Co., Brooklyn, N. Y., 1 50-ton ice making plant; Alex. Manning Estate, Toronto, Canada, 1 125-ton refrigerating machine, condensers, etc.; Green Ice Co., Statesboro, Ga., 1 20-ton ice making plant; Beehive Hygienic Ice Co., Brooklyn, N. Y., 1 150-ton ice making plant; Joy Morton, Hutchinson, Kan., 1 60-ton ice making plant; Canton Provision Co., Canton, Ohio, 1 40-ton refrigerating plant; M. Pilmer, Homeworth, Ohio, 1 6-ton refrigerating plant for creamery; Texas City Oil Refining Co., Texas City, Texas, 1 50-ton absorption refrigerating plant; Ohio Dairy Co., Toledo, Ohio, 1 30-ton refrigerating plant; Meriden Brewing Co., Meriden, Conn., 1 60-ton refrigerating machine; Westerberg & Williams, New York, N. Y., 1 20-ton refrigerating plant for Hudson Chocolate Co., New York, N. Y.; Anderson & Goodman, Chicago, Ill., 1 10-ton refrigerating plant; Wm. A. Kumpf, Carnegie, Pa., 1 15-ton ice plant; J. C. Huhn, New York City, 1 6-ton refrigerating plant; Chas. Leicht Brewery, Newberg, N. Y., 1 30-ton refrigerating plant; Conneaut Creamery Co., Conneaut, Ohio, 1 10-ton refrigerating plant; John Strohm, Ione, California, 1 30-ton refrigerating plant; H. Koehler & Co., New York City, 1 75-ton freezing and distilling system; J. A. Pauli & Co., New York City, 1 10-ton ice plant for Yokahoma, Japan; Missir & Company, Smyrna, Turkey, 1 50-ton ice making plant.

AMONG THE ORDERS RECEIVED FOR SWARTOUT steam specialties for the month of January are the following: National Malleable Castings Co., Toledo, Ohio, 1 3-in. vertical high pressure steam separator, 1 16-in. cast-iron exhaust head and 1 10-in. vertical high pressure steam separator; Tod-Stambaugh Co., Hibbing, Minn., 1 10-in. cast-iron exhaust head, 1 5-in. and 1 7-in horizontal steam separator, high pressure; The Globe-Wernicke Co., Cincinnati,

Ohio, cast-iron exhaust head; Tuberculosis Hospital, Mt. Vernon, Ohio, 16-in. vertical up-current oil separator, 16-in. cast-iron exhaust head and 3 steam separators; Acme Wire Co., New Haven, Conn., 1 8-in. horizontal oil separator; Sterling & Welch Bldg., Cleveland, Ohio, 1 12-in. cast-iron exhaust head; Tiffin Edison Electric Illuminating Co., Tiffin, Ohio, 1 7-in. vertical angle type high pressure separator; Goodyear's Metallic Rubber Shoe Co., Naugatuck, Conn., vertical steam separator; Oglesby Coal Co., Oglesby, Ill., 2 8-in. cast-iron exhaust heads; Westinghouse Air Brake Co., Wilmerding, Pa., 2 cast-iron exhaust heads.

LUBRICATION OF GOVERNOR PINS on flywheel governors is one of the difficult problems in the handling of high-speed engines. The conditions of safe and effective lubrication are severe, as a heavy weight is carried and the movement is through a short arc. Speaking of a test on the Westinghouse high-speed engines at the plant of the Electric Storage Battery Co., Philadelphia, the chief engineer states that he has used Keystone grease and that it gives perfect satisfaction with a consumption of 46 oz. of No. 2 density grease on each engine a week of 13 consecutive shifts. These engines are employed to generate electric current used in the forming and charging of storage batteries, so that the conditions are especially exacting as to speed regulation, and the least tendency of the governor pins to stick would, therefore, condemn the lubricant. The showing is, therefore, specially significant of reliability and efficiency of the Keystone grease used.

ATTRACTIVE OFFERS are being made by the American School of Correspondence of courses in different branches of engineering at special rates. They are offering in one case the Cyclopedia of Engineering at practically half price on reasonable monthly installments, and with the privilege of 5 days' examination. The circulars sent out describing the Encyclopedia tell the story.

FOSTER ENGINEERING CO.'S automatic non-return and emergency stop valves are installed on the 5 boilers of the Singer Building, New York City. A folder describing the valves as there used is being sent out by the company from its office at Newark, N. J.

WATSON-STILLMAN CO., of New York City, has recently placed on the market The Gladstone Patent boiler pump governor, which controls the height of water in the boiler by controlling the supply of steam through the feed pump. It is simple in construction, and is guaranteed by the makers to hold the water level within ¼ in. of the point for which the governor is set.

AN INSTRUCTIVE ARTICLE on "Precautions in Cold Weather for Automobiles," by Herbert L. Towle, in the New York Evening Post for Jan. 18, contains some valuable points on the proper lubrication of automobiles. Referring to the use of grease it is stated: Special care must be taken that the grade used in cold weather is not too stiff to feed. It is better to use a thin mineral grease whose viscosity is not greatly affected by temperature. This kind of grease depends wholly on pressure to feed it, and this point must be borne in mind. An animal grease is not theoretically desirable.

It is claimed by the Keystone Lubricating Co., of Philadelphia, manufacturers of Keystone grease, that the latter exactly fulfills these requirements, as neither its consistency nor its lubricating quality is effected by exposure to low temperature. This product is further stated to be a pure, natural one, free from acid, grit, or other corrosive or obnoxious substances that do much injury to fine gears and bearings under the exact conditions of automobile use. Keystone grease is put out in eight different densities, adapted to the efficient lubrication of all kinds of machinery.

G. M. DAVIS REGULATOR CO. reports the recent shipment to the General Fire Extinguisher Co., Providence, R. I., of a 30 in. pressure reducing valve to reduce pressure of 75 lb. down to 30 lb. It is designed to allow the passage of 20,000,000 gal. of water a day through the valve. Shipment weighed 3 tons and is believed to be the largest pressure reducing valve ever constructed in the country. Further details of this big regulator is promised for a later edition after the regulator is put into operation.

They also report the receipt of an order for a 30 in. combination atmospheric relief and back pressure valve to be used on a 5,000 kw. Curtis turbine being installed in the 59th Street station of the Interborough Rapid Transit Co.'s plant, New York City. This company has 19 30-in. Davis relief valves installed in its plant, which is considered the largest power plant in the world and the largest installation of one type of relief valve.

The valve is designed to remain tight against a 29-in. vacuum and to relieve at atmosphere or any predetermined pressure above atmosphere for which the valve may be set. The change from vacuum to pressure condition in operation is entirely automatic and is the feature that has made Davis combination valves the standard for outboard exhaust lines in connection wtih turbine units.

RECENT SALES OF THE York Mfg. Co. are to the Consumers' Ice & Coal Co., Elizabeth, N. J., 1 100-ton ice-making plant; James G. Nelson, Savannah, Ga., 1 35-ton ice-making plant; Distilled Water Ice Co., Woonsocket, R. I., 1 15-ton ice-making plant; C. A. Durr, Utica, N. Y., 1 20-ton refrigerating machine and piping for packing house; Grazier Bros., and Ellenberg Packing Co., Juniata, Pa., 1 25-ton ice-making plant; L. Schnuth & Sons, Pittsburg, Pa., 1 4-ton refrigerating plant; Dunlevy Bros., Pittsburg, Pa., 1 40-ton refrigerating machine; Crystal Ice & Power Co., Newata, Okla., 1 15-ton ice-making plant; Cudahy Packing Co., Salt Lake City, Utah, 1 10-ton refrigerating plant; Hagedorn Bros., New York, N. Y., 1 60-ton ice-making plant; University of Toronto, Toronto, Canada, 1 3-ton refrigerating plant for testing purposes; Eckles & Sons' Ice Mfg. Co., Baltimore, Md., 1 50-ton ice-making plant; Ebling Brewing Co., New York, N. Y., 1 225-ton ice-making plant; Tegarden Packing Co., Springfield, Mo., 1 20-ton refrigerating plant and direct expansion piping; Seymour Packing Co., Topeka, Kans., 1 175-ton machine and compression side; United Iron Works, Seattle, Wash., 2 8-ton refrigerating machines; Beyer Ice Cream Co., Philadelphia, Pa., 1 65-ton refrigerating machine; Fox River Packing Co., Aurora, Ill., 1 30-ton refrigerating machine and direct expansion piping; Jamaica Consumers' Ice Co., Jamaica, N. Y., 1 135-ton ice-making plant; Luick Ice Cream Co., Milwaukee, Wis., 1 40-ton refrigerating plant and 15-ton ice-making system; Bauman Ice Cream Co., New Castle, Pa., 2 11-ton refrigerating machines; A. E. Munson & Co., Kane, Pa., 1 25-ton ice-making plant; Southampton Ice Co., Southampton, L. I., one 15-ton ice-making plant; Huntington Pasteurized Milk Co., Huntington, W. Va., 2 10-ton refrigerating machines; Philadelphia Freezing & Pipe Line Co., Philadelphia, Pa., 1 125-ton refrigerating machine; Mercy Hospital, Iowa City, Iowa, 1 2-ton refrigerating machine; W. H. Kough-

an, McKeesport, Pa., 1 30-ton refrigerating machine; 10-ton ice-making system and refrigerating system for ice cream factory; Michael Brewing Co., Brooklyn, N. Y., 1 60-ton freezing system.

MESSRS. ADAM COOK'S SONS have designed a special cast spindle grease cup for use on loose pulleys in connection with their Albany Grease as a means to perfect lubrication. That the combination is a winning one is conclusively shown in the experience of D. B. Cobb, chief engineer of the Glenwood Cotton Mills, Easley, S. C., who writes as follows:

"We have here a clutch pulley that drives the dynamo; for the past 4 yr. it has burned out one set of sheaves every season, and it only runs about 4 hr. a day, and at that we had to be continually on the watch.

"Now, I want you to understand I have been a user of Albany Grease for a number of years and do not think there is a better lubricant in the world for engines, line shaft, etc., but I have never had the satisfaction with the use of it that I have had since I got this cup. You see the spring cup forces the grease through when it is not needed and is wasted, but this one is absolutely automatic and lets the grease through just as it needs it and keeps the parts cool."

The Albany loose pulley cup is provided with a spindle, which is in contact with shaft at all times. The centrifugal force is overcome, due to the Albany Grease remaining at the same consistency, except that portion adjacent to the spindle, which liquifying, is drawn to the shaft by capillary attraction or otherwise under the influence of molecular attraction, lubricating the bushing of the pulley. Equally good results are reported from abroad, where the Albany cup and Albany Grease have been adopted for loose pulley lubrication.

WANTED

"Positions Wanted" advertisements not exceeding 50 words for subscribers to Practical Engineer will be inserted twice free of charge. "Help Wanted" and special advertisements 25 cents a line.

POSITION

Engineer wants position. Thoroughly experienced with Corliss and slide valve engines. Now employed. Can give references. Address P. O. Box 218, Londonville, Ohio. 3-2

POSITION

As engineer in some large or medium size plant by sober, industrious worker. Employed at present, but prefer the south or southwest. Address E. A. Landis, 1642 W. Monument Ave., Dayton, O. 2-2

POSITION

As assistant engineer or fireman. Have had six years' experience and have nearly completed engineer's course in I. C. S. Can furnish references or come on trial. Address F. F. Ninman, Belle Plaine, Wis. 2-2

POSITION

At firing by young man 19. Some experience, strictly sober, handy at steam fitting. Prefer small plant in Milwaukee or Chicago, but will go anywhere. Give full particulars first letter. Address Box 97, Practical Engineer. 2-2

POSITION

As second-class engineer, oiler or helper in steam plant. Have second-class Minnesota license. Can give references, or would come on trial. Good, steady worker. Prefer Minnesota or Wisconsin. E. Pascoe, Box 116, Deerwood, Minn. 2-2

POSITION

Engineer now employed by Produce Cold Storage Co., wishes to make change. Experienced with steam and refrigerating machinery and pumps. Strictly sober and steady. Can furnish references. Address R. J. Carrier, 5 Montezuma street, Houghton, Mich. 3-2

POSITION

By young married man in some large plant in Ohio or adjoining states. Have had several years' experience with steam engines. Can give reference. Address E. G. Merritt, Casstown, Ohio. 2-2

POSITION

Gas engineer is open for position. Ten years' experience erecting and operating Westinghouse and Allis-Chalmers gas and steam engines. Past three years on gas engines exclusively. First class references furnished. Age 35. Married. Address Box 98, Practical Engineer. 3-2

POSITION

I wish to correspond with any company desiring the services of an up-to-date master mechanic or chief engineer. Thoroughly familiar with all kinds of repairs and reconstruction work in manufacturing plants. Address M. D. Morley, 112 Chadwick avenue, Newark, N. J. 3-2

POSITION

Electrical engineer, first-class license, wishes to better his position. Technical training in university and experienced in ice making and refrigerating machinery. Strictly sober, 27 years old. Am looking for a permanent position with a good firm. Best references or recommendations. H. M. Warner, Lock Drawer Box 5, Station F, Cleveland, O. 2-2

POSITION

General superintendent and works manager will be at liberty February 1st. Ten years with high-class concerns in Middle West; experienced in foundry, machine, sheet metal, forge and woodworking lines, with up-to-date ideas of shop organization and practice on economical production. Address "Superintendent," 1105 N. Alabama Street, Indianapolis, Ind.

POSITION

By young man as assistant or oiler in engine room. Have finished complete steam engineering course of I. C. S. as far as engine management. Age 22, sober and industrious. No experience. Give full particulars. Address Le Roy Scott, Box 360 East Jordan, Mich. 2-2

POSITION

Engineer with fifteen years' experience with steam plants for office buildings, hotels, department stores and waterworks desires change of situation. Graduate of International Correspondence Schools. Age 35; highest class references. Address R. Cederblom, Box 757, Gary Ind. 2-2

SALESMEN WANTED

To introduce our New Commercial and Statisical State Chart for office and general use. The work is congenial and profitable, the earnings being according to your ability. A thorough training is given before the work is started. Rand, McNally & Co., Chicago, Ill. 10-5

WANTED IMMEDIATELY.

A high grade salesman with experience in selling machinery and equipment in the power plant field. Must have a record showing ability to develop and close sales with big industrial establishments, consulting engineers and architects. Preference will be given to an ex-Allis-Chalmers or Westinghouse man, but consideration will be given all applicants. An excellent opportunity for the right man. Address Box 94, Practical Engineer.

REPRESENTATION

A hustling manufacturing concern of the Middle West, building a high grade line of steam and oil separators and steam traps, desires representation in the larger cities, both east and west. An opportunity for a live contracting engineer whose present line does not conflict with our products. Address Box 93, Practical Engineer. 2-2

FOR SALE

60 steel storage tanks, 6,000 gallons' capacity. Good as new. Double riveted, extra well built. Suitable for storage of oils, waters or liquids of any kind. 100 steam pumps. Get our prices on engines, boilers and electrical machinery. All sizes and kinds. Chicago House Wrecking Co., 35th and Iron Sts., Chicago. 4 tf

ENGINEERS AND MECHANICS

To make big money selling Incomparable "ZIZ" Hand Soap. A 10-cent can will instantly remove more dirt and stains from the hands than four cakes of any soap made, and it will not injure the most delicate skin. Small sample free. Byram Mfg. Co., Box 3133, Boston, Mass. 4 tf

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PATENTS

C. L. Parker, late Examiner, U. S. Patent office, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. 4 tf